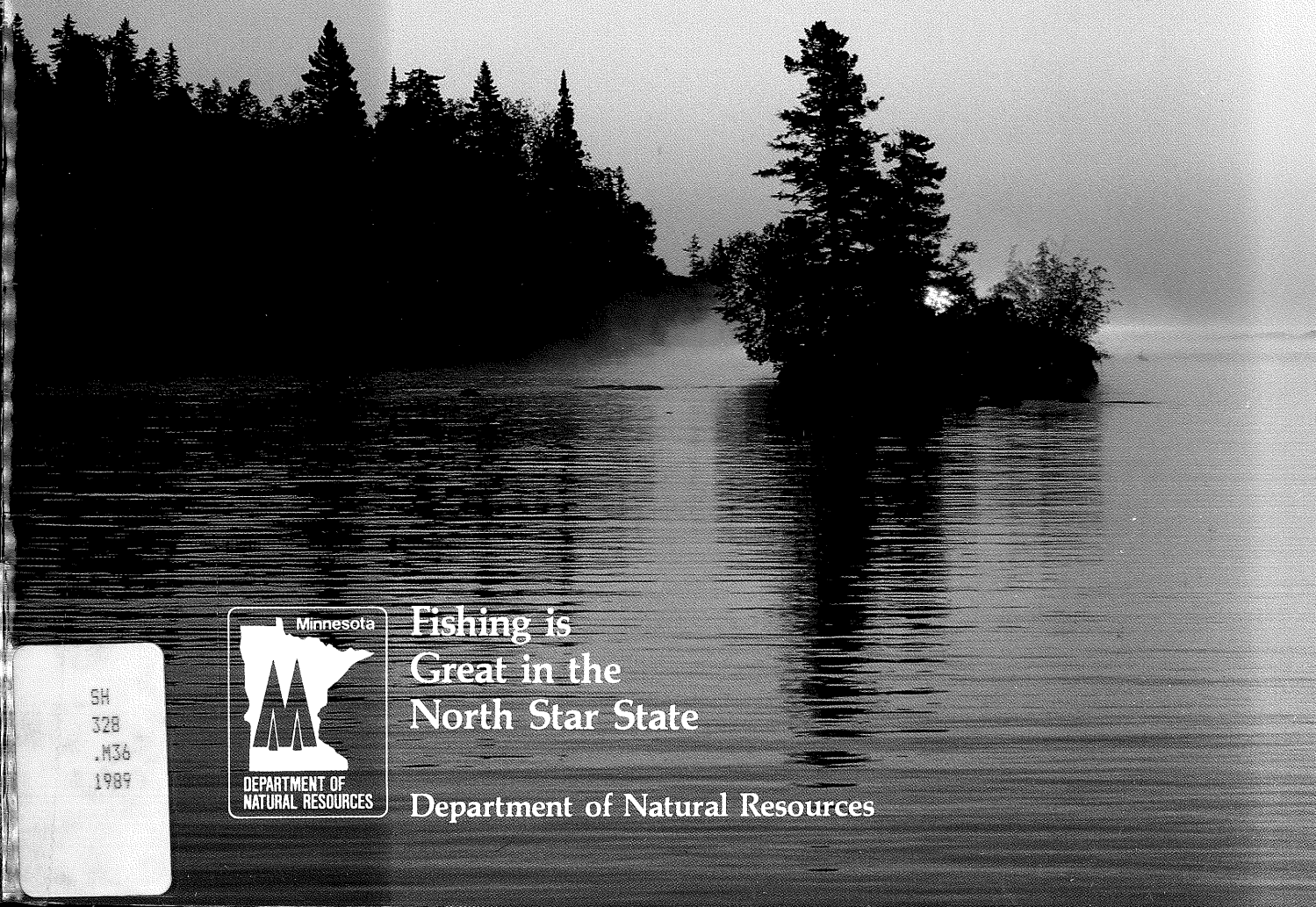
naging Minnesota's Fish



Minnesota
DEPARTMENT OF NATURAL RESOURCES

Fishing is Great in the North Star State

Department of Natural Resources

Credits

Produced by the Department of Natural Resources, Section of Fisheries
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Fish Illustrations:

Brook, brown and rainbow trout; yellow perch; largemouth and smallmouth bass; bluegill, pumpkinseed, black and white crappie (Panfish section), white bass; and channel catfish provided by the Department of the Interior, U.S. Fish and Wildlife Service. Artist: Duane Raver.

Lake trout, lake sturgeon, smelt, chinook, coho, pink, Atlantic salmon; walleye, sauger; whitefish; crappie (Managing Minnesota's Fish section), green sunfish, rock bass, yellow bass, flathead catfish, black and brown bullheads provided by Windsor Publications, 2515 Windsor Circle, Eugene, Oregon 97405. Artist: Ron Pittard.

Northern pike, muskie, and tiger muskie provided by Muskies, Inc. Artist: Virgil Beck.

Orangespotted sunfish provided by the Iowa Department of Natural Resources. Artist: Maynard Reese.

Yellow bullhead provided by Duane Raver.

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Bob Firth: cover
Greg Ryan and Sally Beyer, back cover

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MN Office of Tourism, pages 1, 12
The Hunting & Fishing Library, pages 3, 4, 5, 6 (fish), 7
Robert Megard, U of M, Dept. of Limnology, page 6
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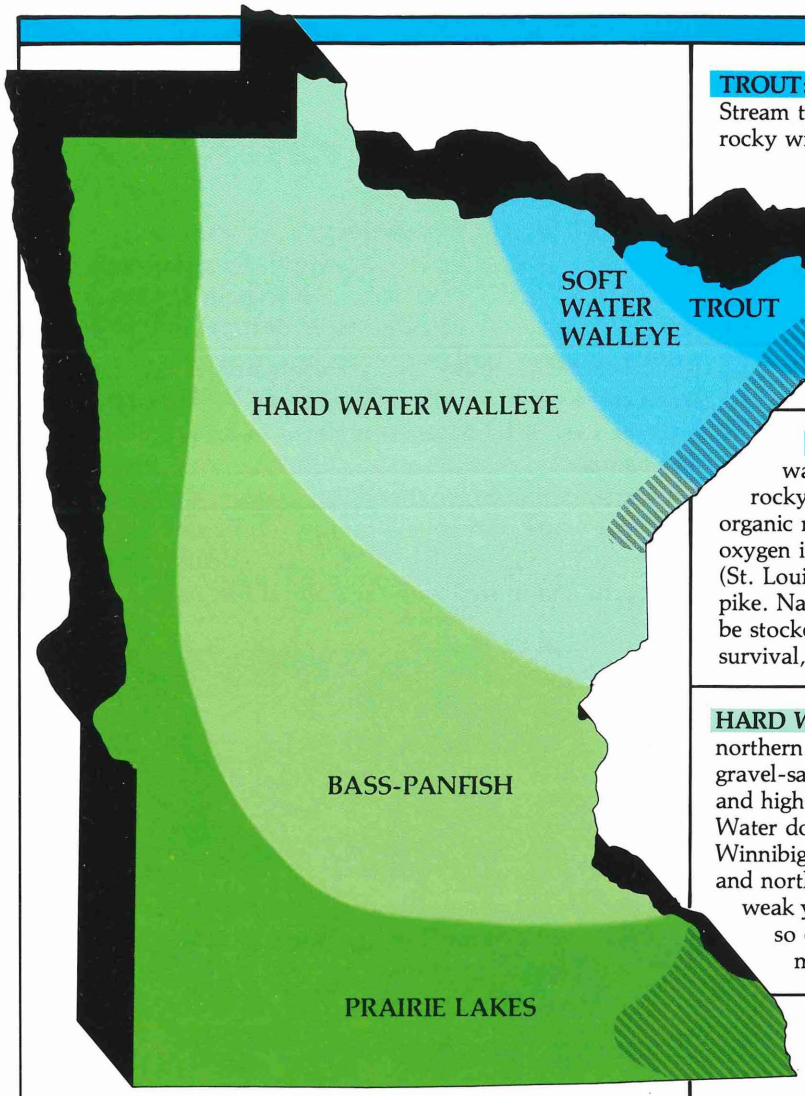
Managing Minnesota's Fish

Half a century ago, fish management consisted of a few regulations and planting little fish in every puddle and rivulet with the vague hope they would grow to be big fish. Stocking was to fish what spring planting is to corn.

Dubious introductions were attempted. The chinook salmon, native to the Pacific and its cold, clear, tumultuous tributaries, were stocked unsuccessfully in the Mississippi River and small, warm lakes in southern Minnesota. Even today, many anglers believe that any lake can be made a walleye lake simply by stocking walleye, even if by nature it is suited to bass, bullhead and panfish.

Experience has shown that this management by chance is often a waste of time and money. To be successful, management must be clear in its goals, scientific in its approach, and in step with the natural fish habitat.



Minnesota's Natural Fish Habitat

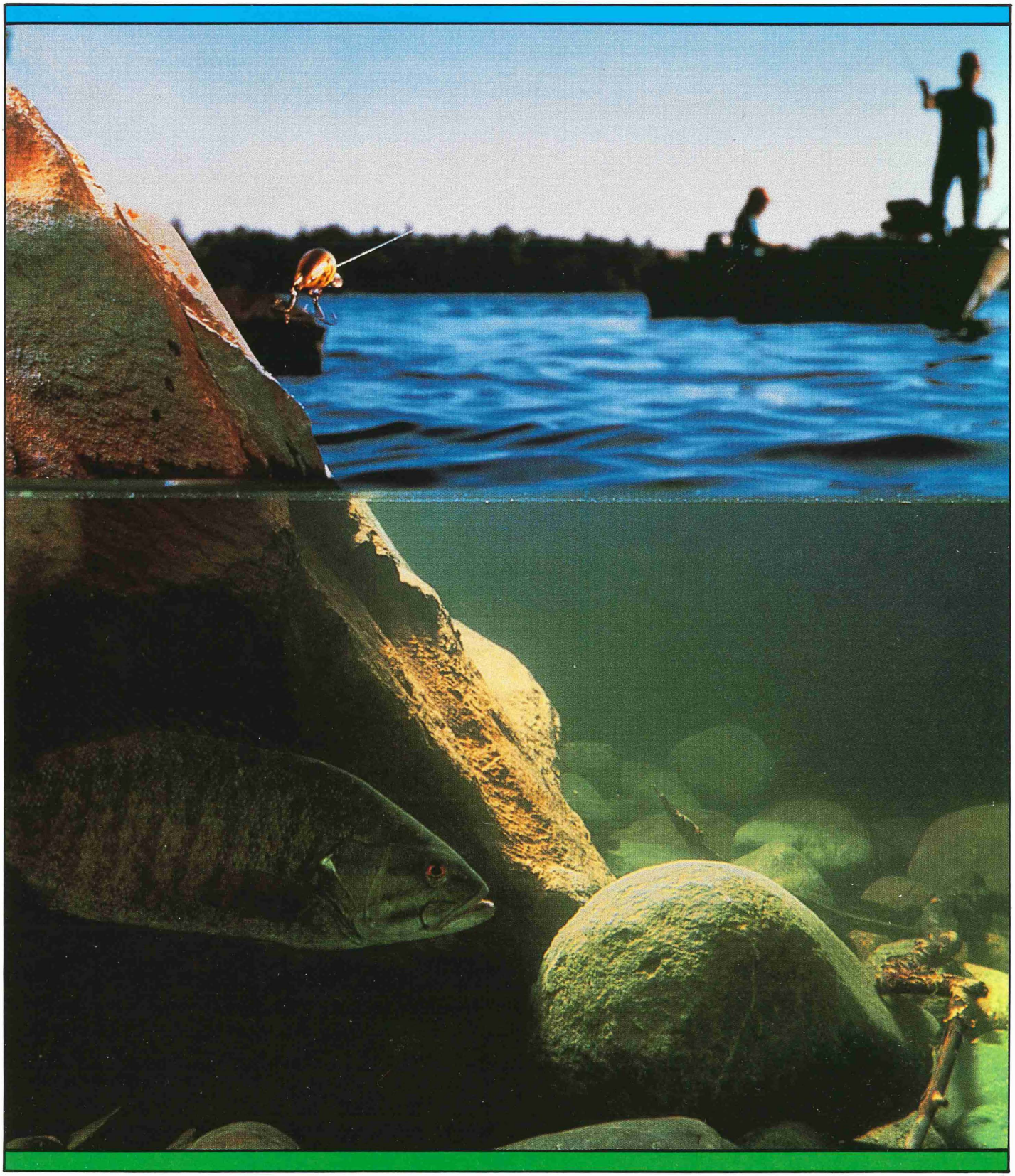
TROUT: Principal species are lake trout, tullibee and suckers. Stream trout have been introduced to some lakes. Deep and rocky with steep shorelines. Low fertility and alkalinity. Water doesn't exceed 70 degrees and is well oxygenated. Examples: Mountain, Clearwater (Cook County), Lake Superior. Management usually rules against introducing competing species into lake-trout lakes unless a relatively uninhabited shallow environment allows a "two-story" fishery. Introduction of stream trout usually requires that native fish are removed.

SOFT WATER WALLEYE: Principal species are walleye and northern pike. Deep, cool and rocky — similar to trout lakes, though decomposition of organic materials on the lakebed may deplete deep water of oxygen in summer. Examples: Pike (Cook County), Vermilion (St. Louis County). Management favors walleye and northern pike. Natural spawning areas will be protected. Walleye may be stocked occasionally where conditions are good for their survival, but natural spawning is poor or sporatic.

HARD WATER WALLEYE: Principal species are walleye, northern pike and yellow perch. Medium to large lakes with gravel-sand bottoms and extensive shallows. Moderate fertility and high alkalinity. Deep water may lack oxygen in summer. Water doesn't exceed 75 degrees. Examples: Mille Lacs, Winnibigoshish, Leech. These lakes are managed for walleye and northern pike. Walleye stocking may be used to bolster weak year classes, but many lakes are so big and spawning areas so extensive that stocking has little effect. Special regulations may be used to provide for more large fish.

BASS-PANFISH: Also common are northern pike and yellow perch. Medium to large lakes with many bays and broad shallows and bottoms of sand, gravel and organics. Moderate fertility and high alkalinity. Deep water may lack oxygen; temperature doesn't exceed 80 degrees. Examples: Minnetonka (Hennepin County), Sallie (Becker County), Gladstone (Crow Wing County), Maple (Douglas County). Where demand justifies the cost, walleye may be stocked to compensate for limited natural reproduction, but not in numbers great enough to harm bass or panfish populations. Bass and panfish reproduction usually is sufficient if habitat is good.

PRAIRIE LAKES: Fertile, hard water lakes with gravel-sand-organic bottoms and extensive shallows. These lakes can harbor game fish as well as less desirable species, such as carp, buffalo, freshwater drum (sheepshead) and bullhead, which may be removed by commercial fishing. Because these lakes occasionally winterkill, managers aim to build up the numbers of game fish as quickly as possible through stocking. Aeration devices are placed in some of these lakes to prevent winterkill. Examples: Tetonka (Le Sueur County), Long (Ramsey County), Madison (Blue Earth County).



Lake Fertility

Minnesota's 15,000 lakes range from the trout lakes of the northeast to the prairie ponds of the southwest. One can hardly imagine greater contrast.

The trout lake is cool, deep, rocky, crystalline. It seems the kind of pure, natural environment in which fish would thrive.

During the summer, the prairie lake may be ripe with blue-green algae. Yet the prairie lake produces more fish, supporting 10 times or more the poundage of fish per acre, than the trout lake, which, despite its beauty, is relatively sterile.

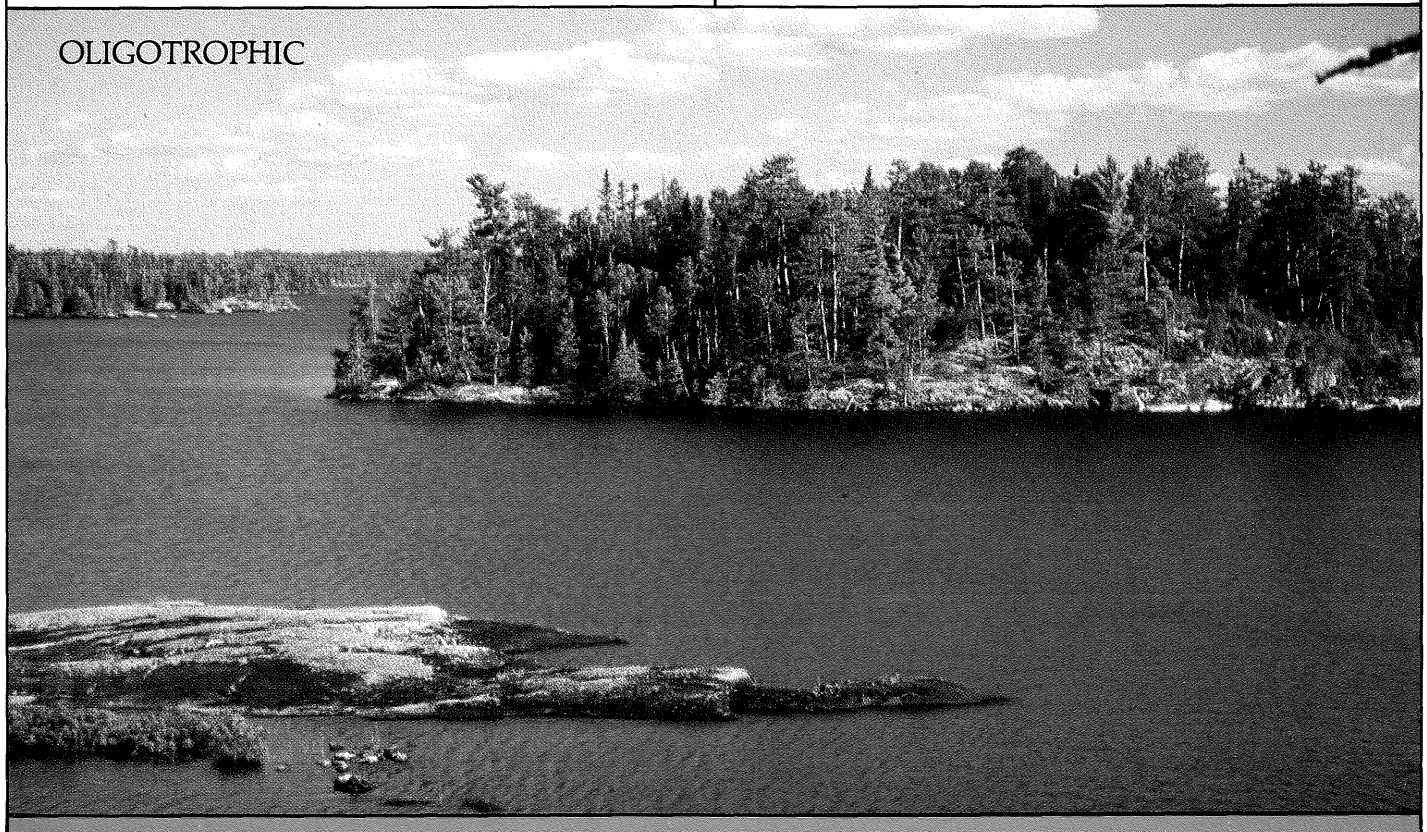
Fertility is one of the most important limits on the number and size of fish in a lake. Like lakes themselves, fertility is a legacy of the glaciers that scoured the area more than 10,000 years ago.

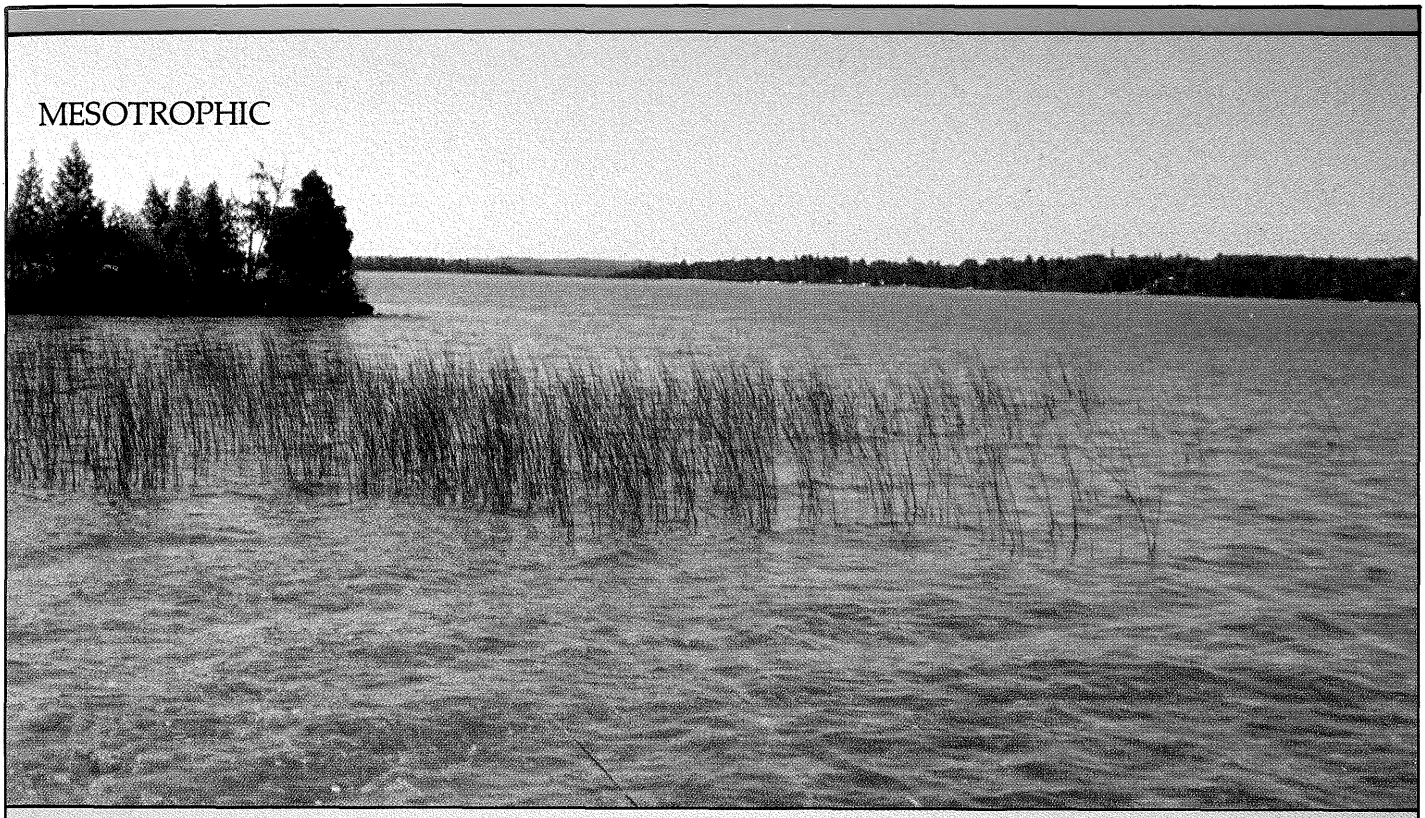
The ice scraped northeastern Minnesota bare, gouging lake basins from granite and other nearly insoluable bedrock. Consequently, many of these lakes have steep, rocky shores and contain few nutrients, such as compounds of phosphorus or nitrogen, that would fertilize the water. There is little lime or carbonate to make the water alkaline, or "hard," and further contribute to its productivity. These lakes, as infertile as the flinty ground on which they lie, are called **oligotrophic** ("scantly nourishing").

The lakes of central Minnesota lie in sand, gravel and other glacial debris. Just as the ground here is fair farmland, these lakes are fairly rich in fish and other aquatic life. The land here is gentler and more rounded than the dramatic cliffs and jagged terrain of the northeast. Consequently, shorelines and shallows are more gradual, the basins shallower. These lakes are called **mesotrophic** ("moderately nourishing").

Southern lakes are **eutrophic** ("richly nourishing"), as fertile as the rich farmland around them. Many basins have scarcely more feature than saucers — a trait enhanced by sedimentation due to land erosion.

Climate exaggerates the effects of geological fertility and basin shape. The cool weather and short growing season of the north limit aquatic life in the already infertile environment. The longer growing season in the south enhances growth in the naturally fertile water.

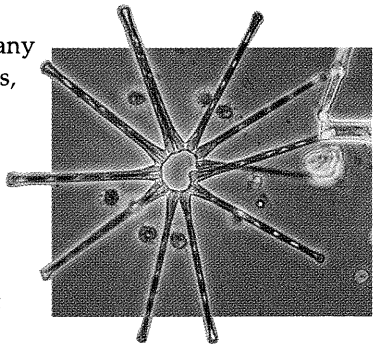



MESOTROPHIC

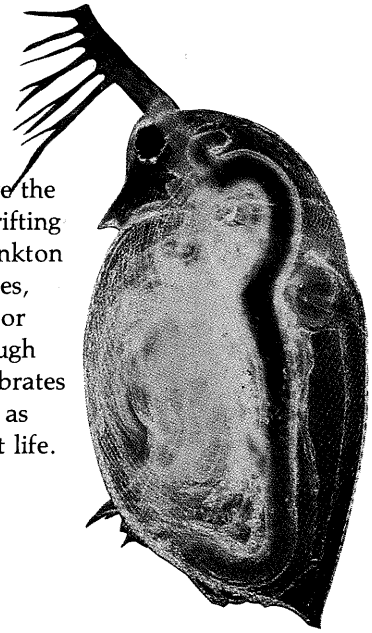

EUTROPHIC

Pyramid of Life

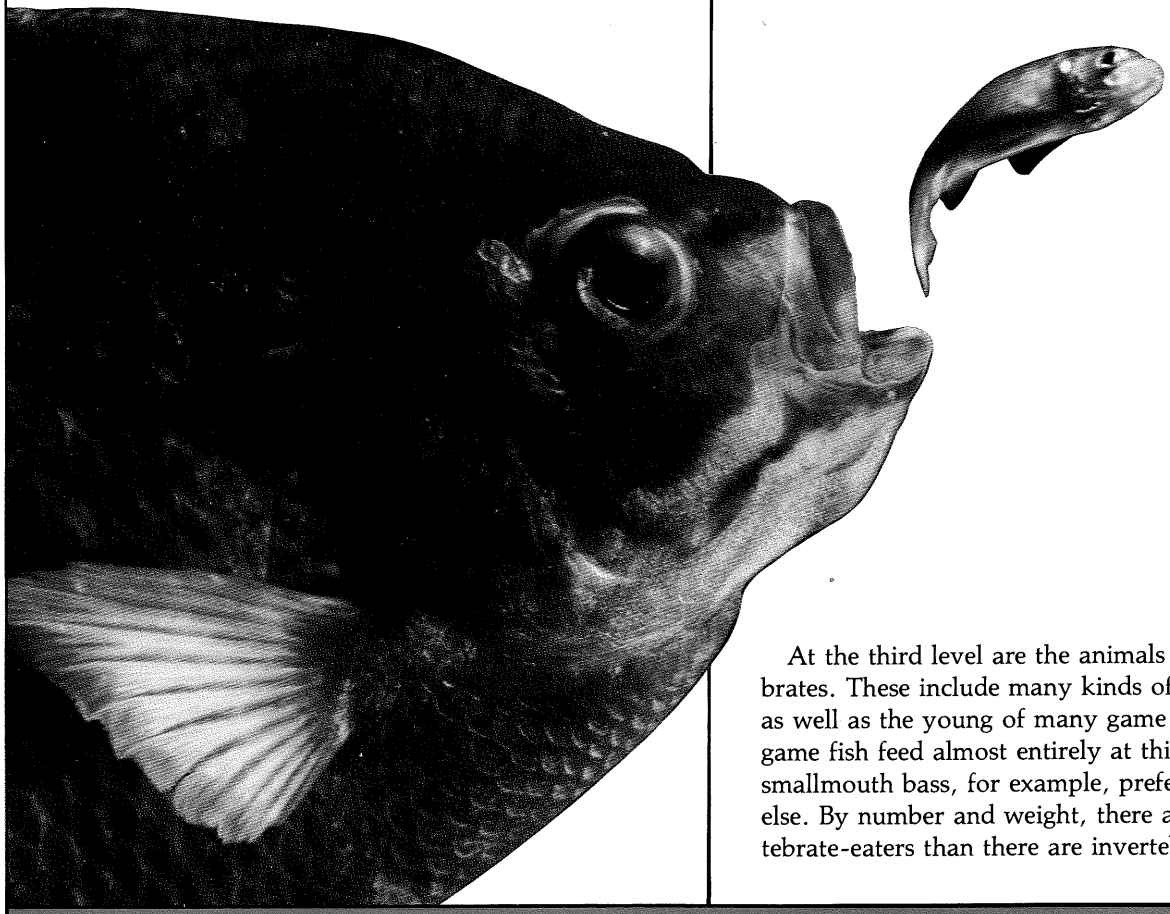
Aquatic life, in any lake, can be arranged in a pyramid.



At the base are many tons of aquatic plants, including emergent cattails and lilypads, submerged coontail and pondweed, and the swarm of microscopic plants called phytoplankton adrift in the water. These plants, which make up the greatest biological mass in any lake, provide oxygen and food to animal life.



At the next level are the plant-eaters—small drifting animals called zooplankton and larger invertebrates, such as caddis larvae or mayfly nymphs. Though abundant, the invertebrates weigh only a fraction as much as a lake's plant life.



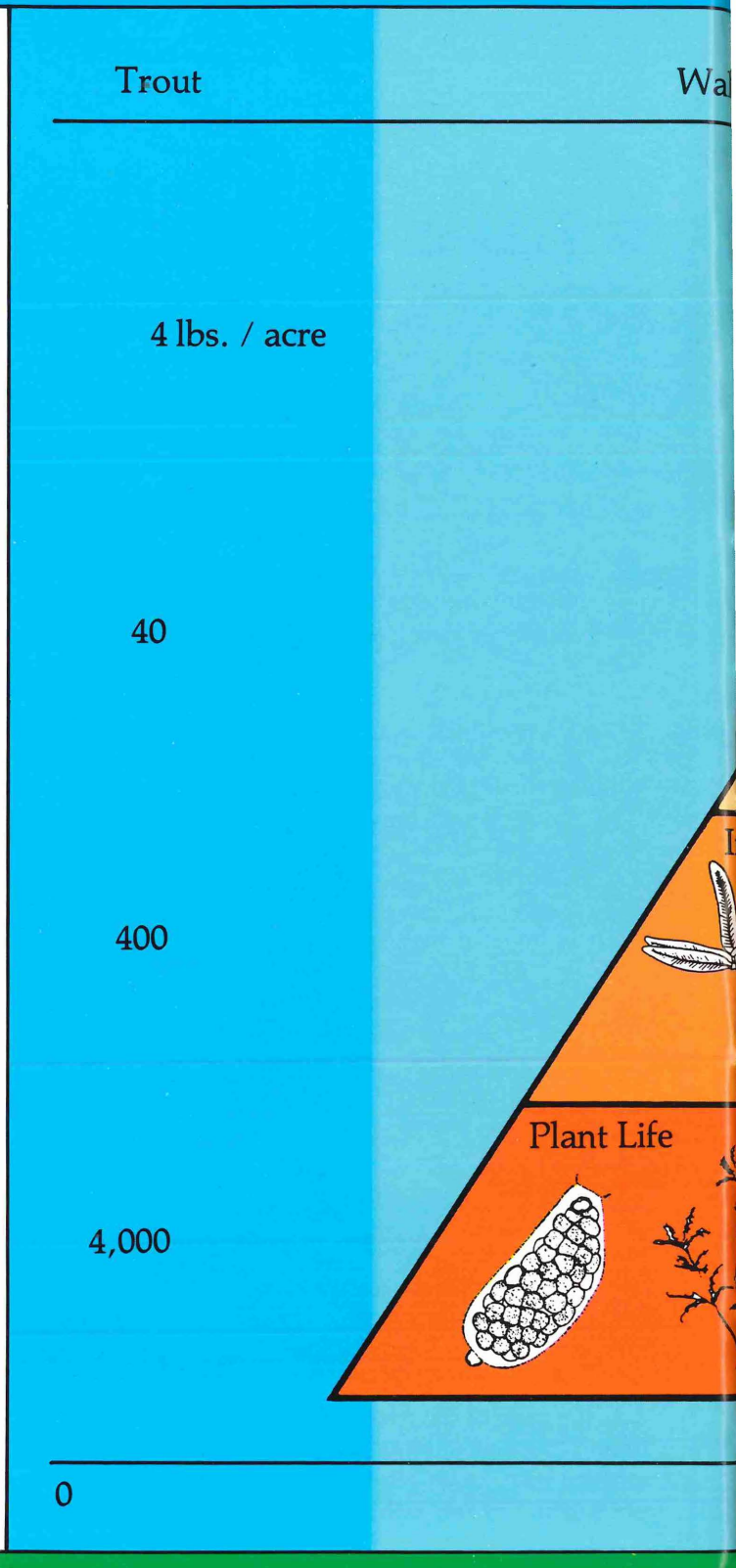
At the third level are the animals that eat invertebrates. These include many kinds of small forage fish, as well as the young of many game fish. Some adult game fish feed almost entirely at this level. The adult smallmouth bass, for example, prefers crayfish to all else. By number and weight, there are far fewer invertebrate-eaters than there are invertebrates.

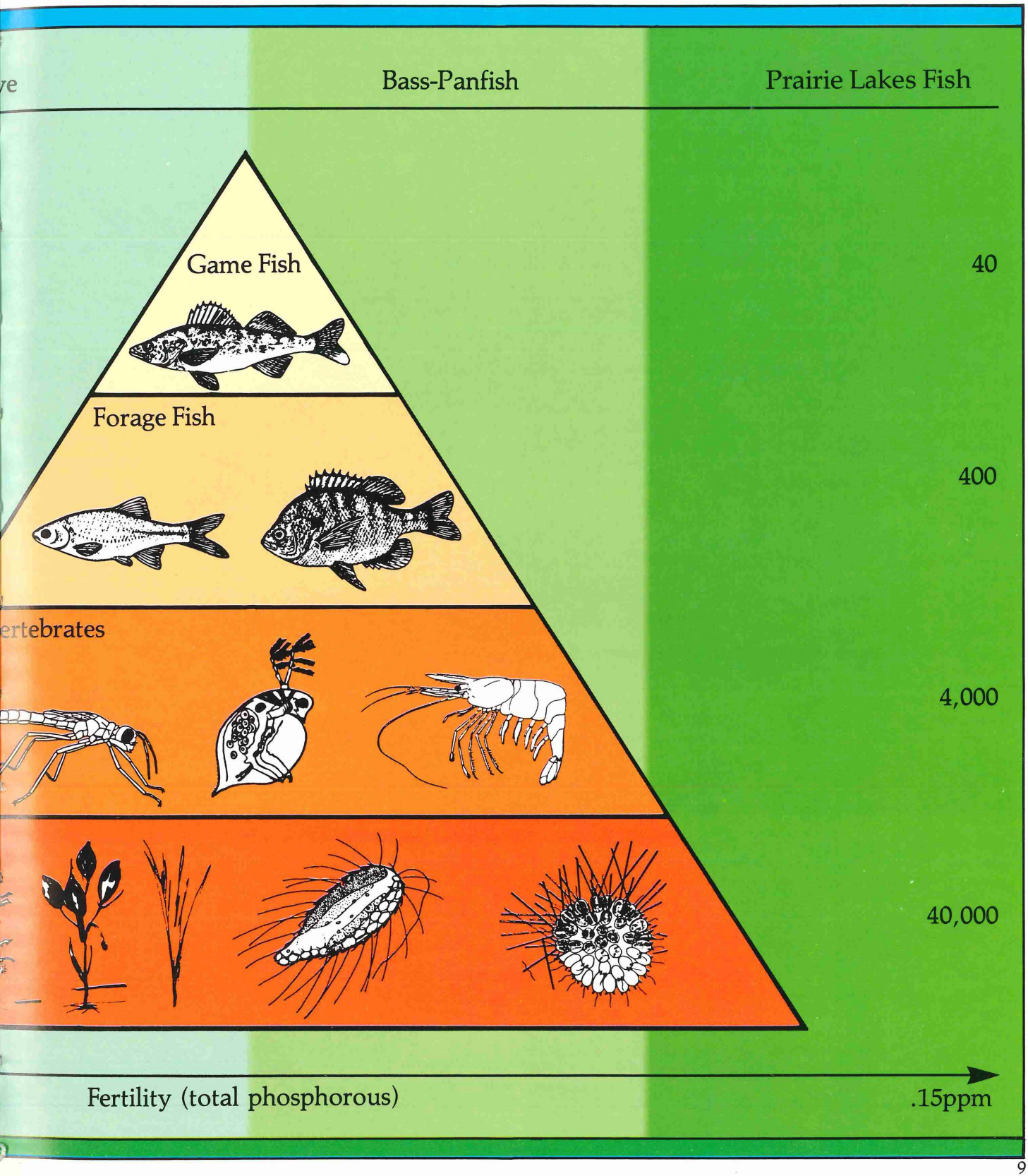
At the peak of the pyramid are the fish that eat fish. These include most large game fish. Some, such as northern pike, begin eating fish almost from the day they hatch. Others, such as most trout, switch from invertebrates to minnows much later and can live entirely on aquatic insects if forage fish are not available. By weight, these high-level predators are the scarcest creatures of all.

Generally, the greater the plant mass at the base of the food pyramid, the greater is the number and weight of game fish at the top. For that reason, the infertile lakes of northern Minnesota may harbor 40 pounds of fish per acre; lakes in southern Minnesota may support 400.

At first glance, it would seem the more nutrients and plant life in a lake, the better. But, while plants provide food and oxygen to a lake, they also **consume** oxygen as they decompose. This oxygen consumption may cause "winterkill" when lake ice prevents atmospheric oxygen from recharging the lake. Fish kills may also occur on cloudy summer days when oxygen-producing photosynthesis slows, but decomposition and oxygen consumption continue apace.

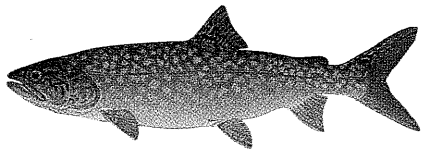
In addition to food and oxygen, however, game fish need spawning areas, suitable water temperatures and shelter from predators. Because different fish have different needs, these factors will determine not only the abundance and size of fish, but the kind of fish in a lake as well. Fisheries managers find it useful to classify lakes by their dominant large-fish species as a way of tying together the environmental characteristics. Under this system, Minnesota has the following lake types: trout, soft water walleye, hard water walleye, bass-sunfish, prairie lakes. (Northern pike are omitted, because they live in nearly all but the warmest Minnesota lakes.) Minnesota streams are categorized in two groups: trout streams and those that are not.




Bass-Panfish
Prairie Lakes Fish
Game Fish
40
Forage Fish
400
ertebrates
4,000
40,000
Fertility (total phosphorous)
.15ppm

Minnesota Game Fish

LAKE TROUT: Inhabiting Lake Superior and deep, cool, oxygen-rich inland lakes of northeastern Minnesota, especially B.W.C.A.W. lakes, the lake trout is the state's largest trout. Though Superior has yielded fish larger than 40 pounds, the typical laker weighs about three pounds. They spawn on rock rubble or reefs just before ice-up in the fall. Adults normally feed on tullibee, smelt or other small fish, but will rely on invertebrates if no forage fish are available. During the mid-1900s, Lake Superior fish were decimated by the sea lamprey's invasion of the Great Lakes.

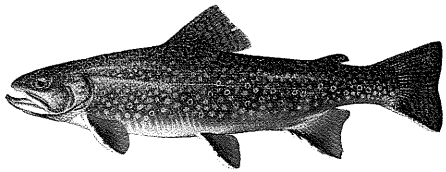


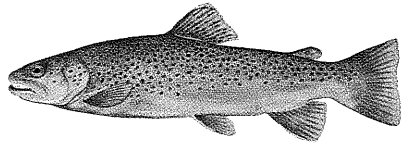
STREAM TROUT: Of Minnesota's four species of stream trout, only the brook trout is native, originally inhabiting Lake Superior, its tributaries, and a few small, cold lakes and streams in the state. Its range has been increased through stocking, but it also has suffered from overfishing, poor land use and development. A fall spawner, the brook trout rarely exceeds a pound in small streams. Lakes produce larger fish, sometimes larger than three pounds.

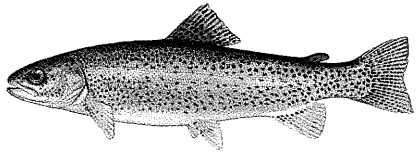
Brown trout from Europe were introduced to Minnesota and much of the United States during the late 1800s. The brown has adapted well, tolerating warmer water than the native brookie and supplanting it in many waters. The brown spawns in streams in the fall and occasionally exceed 10 pounds. It is most abundant in streams of southeastern Minnesota, but also is found in the Lake Superior watershed and in other trout waters in the state.

The rainbow trout, like the brown, was stocked in Minnesota a century ago. It has become particularly important with self-sustaining populations in Lake Superior and North Shore streams. Lake Superior rainbow are known as "steelhead" and may exceed 12 pounds. They ascend tributaries in the fall and spring, spawn in the spring, and swim downstream to the lake, as do the fingerling trout.

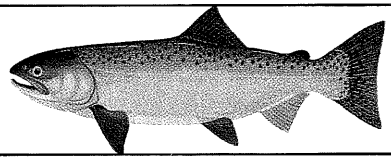
Atlantic salmon are an Atlantic coast species of trout, introduced recently to Lake Superior, where they form a small part of the fishery.







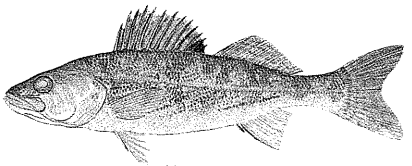
PACIFIC SALMON: Three species of Pacific salmon (pink, chinook, coho) have been introduced recently to Lake Superior. All feed in the open waters of Lake Superior until they reach sexual maturity. Then they ascend rivers in the fall to spawn and then, inevitably, die. The chinook, or king, salmon is popular with anglers because of its size — sometimes heavier than 20 pounds.

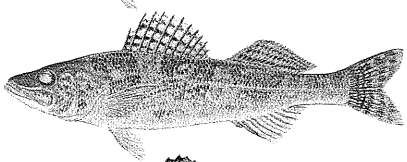


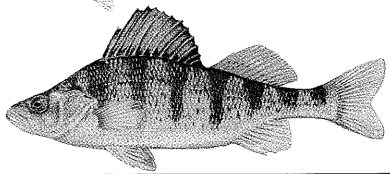
WALLEYE, SAUGER, PERCH: Walleye, prized for its flavor more than its fight, is the most popular game fish in Minnesota. Occupying large lakes and streams throughout Minnesota, the walleye spawns in the spring on sandy or gravelly shores or river beds. Walleye and sauger have evolved light-sensitive eyes to help them feed at night or in turbid water. Their food consists largely of small fish as well as various invertebrates. The walleye in particular feeds heavily on yellow perch. Walleye occasionally exceed 12 pounds; two pounds is common.

Sauger are similar to walleye in appearance and habits, though their distribution is more limited — Lake St. Croix, the Minnesota River, and the Mississippi below the Twin Cities. They also are common in Lake of the Woods, Rainy Lake and Lake Kabetogama. Sauger are smaller than walleye, and are not as highly esteemed by anglers.

Yellow perch are found throughout the state, often in such numbers they are stunted for lack of food. Occasionally infected with unappetizing parasites, they are not sought after except in large hard water walleye lakes, where they exceed a pound and are excellent table fare.





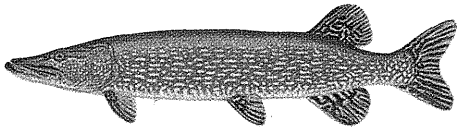


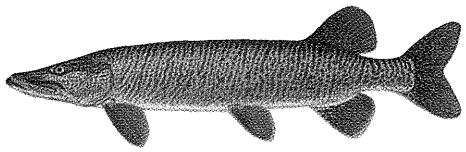
PIKE: Northern pike and the closely related muskellunge are infamous savagers of lures and forage fish. Built long and lean for quick acceleration out of cover, both species ambush their prey with a mouthful of needle-like teeth.

Northern pike are one of our more common game fish, occurring throughout the state. They spawn soon after ice-out in seasonally-flooded marshes. They are one of our largest game fish with adults sometimes surpassing 20 pounds.

Muskies grow slightly larger and are even more prized as a trophy fish. They are more limited in their range, inhabiting parts of the Mississippi and St. Croix rivers, the Rainy River drainage, Leech and Cass lakes and scattered lakes elsewhere. Even where they occur, they are never abundant.

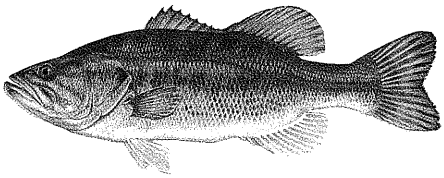
A sterile hybrid of pike and muskie — the tiger muskie — is stocked in several heavily fished lakes in the Twin Cities area.

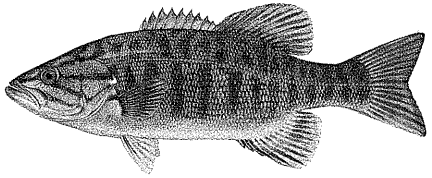




BASS: Valued by sports anglers for their fight and willingness to hit artificial lures, largemouth bass are common in lakes and slow streams everywhere except the cold, infertile lakes of the northeast. They gobble up large aquatic insects, frogs, crayfish, mice and nearly any other small animal unlucky enough to tumble into shallow water. Bass spawn in sandy or silty shallows in May and June, when they are easily caught. The largemouth grows to five pounds or more.

Smallmouth bass are slightly smaller but are every bit as full of fight as largemouth. Primarily a river fish, they inhabit many warm water streams of the Mississippi and St. Croix drainages. They also are common in the soft water walleye lakes of the northeast, though they probably are not native there. The smallmouth spawns in gravelly shallows in May and June. They feed overwhelmingly on crayfish, but also on small fish and large aquatic insects.



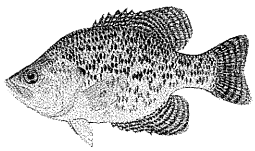


SUNFISH: The various species of sunfish are probably the most commonly caught game fish in the state. The most important species are black crappie, white crappie, bluegill and pumpkinseed. Other common species are rock bass and green sunfish.

Black crappie and white crappie are the largest fish of the group, occasionally exceeding two pounds. Both species travel in schools, sometimes feeding in open water, at other times holding near cover. They eat a variety of small fish, aquatic insects and other invertebrates.

Other sunfish are often called simply "sunnies" without regard to species. Of these, bluegill and pumpkinseed are the most widespread and among the largest, sometimes reaching a pound. In early spring, they congregate in sandy shallows, where they scour nests and spawn.

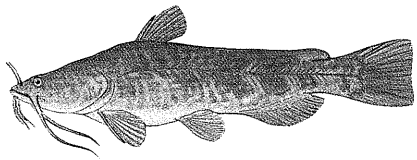
Sunfish are particularly prone to "stunting." A lake with abundant spawning habitat and meager food can produce a swarm of small adult fish that never grow large.

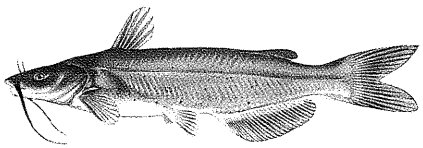


CATFISH: The catfish family includes one of Minnesota's largest game fish — the flathead, which exceeds 50 pounds — as well as the much maligned but often caught bullhead. All of the catfish are omnivorous, though the flathead and channel catfish prey heavily on small fish. All catfish have stout, sharp spines in the leading edges of their dorsal and pectoral fins which can inflict punctures and cuts. The eight barbels, or "whiskers," are harmless; they are organs of smell, helpful in locating food.

Flathead catfish occupy large rivers, including the Mississippi south of the Twin Cities, the Minnesota and lower St. Croix.

Channel catfish are more common and inhabit the swifter portions of these same streams and their steeper tributaries. Channel cats occasionally hit artificial lures and flies and are strong fighters, sometimes surpassing 15 pounds.





Management

As the classifications imply, water should be managed for the fish best suited to inhabit them. But, while fish exist in an aquatic environment, fish management exists in a political one. Decisions must contend with conflicting desires, meager funds, and the unassailable belief of many anglers that each alone knows why fishing isn't as good as it used to be and how it could be made better.

Most anglers would agree, however, that the broad goal of fisheries management is the cost-effective improvement of recreational fishing. But, while the problems of a fishery are often apparent, the solutions often are not. The fish manager has several options. One state manager correctly remarked, "Basically there are four things that we can do to manage fish: Put them in, take them out, change and protect habitat, and regulate the harvest."

Put Them In

To many fishermen, stocking fish is the best way to improve fishing — the essence of fish management. The truth is, it is expensive. If not properly done, it may be harmful, as was the much-heralded introduction of carp a century ago or the invasion of smelt and alewives to the detriment of native Great Lakes forage fish. In many circumstances, stocking is a complete waste of time and money.

Consider that Minnesota maintains the most extensive walleye hatcheries and rearing ponds of any state; yet its entire production is far less than the number of fry produced by naturally spawning walleye on a lake such as Mille Lacs in a single good spring. To put the state's entire stock of walleye into one of these natural walleye factories would have little effect.

Likewise, to stock walleye where they are unlikely to survive and be caught is to waste an expensive commodity that could be better used elsewhere.

Still, stocking is a useful tool for some purposes:

- To repopulate newly created waters and lakes that have been "rehabilitated" (that is, where the previous fish were deemed undesirable and removed).
- To restock heavily used lakes occasionally suffering winterkill.
- To introduce a highly desired fish (such as trout) to a lake where it can survive without harming native fish. The popular Lake Superior steelhead and chinook salmon fisheries began this way.
- To maintain game fish in waters with all elements necessary for survival except suitable spawning areas.
- To remedy an imbalance between few predators and many prey.
- To compensate for successive years of poor spawning due to unusual circumstances.
- To bolster the number of catchable fish where heavy use justifies the expense.

Take Them Out

Fish occasionally are removed to make way for a popular but incompatible species. Thus, some lakes have been "rehabilitated" by removing the original occupants and planting trout. In other lakes, northern pike have been replaced with muskellunge or walleye.

Maintaining Habitat

Much fish habitat is protected through laws controlling water pollution, shoreline development and water appropriation. Good land management protects fisheries by slowing run-off and preventing soil erosion and sedimentation.

The most intensive form of habitat improvement occurs on trout streams, where the DNR and volunteer angler groups stabilize banks and place structures in streams to improve depth, aeration, cover and spawning habitat.

The Section of Fisheries sometimes buys marshy shoreline to protect it for reproducing and rearing northern pike or muskies. In some instances, the Department builds low dams to flood these areas in the spring to enhance spawning.

The DNR also builds barriers on many creeks and rivers to keep undesirable fish, particularly carp and bullhead, from water where they would compete with game fish and harm game fish habitat.

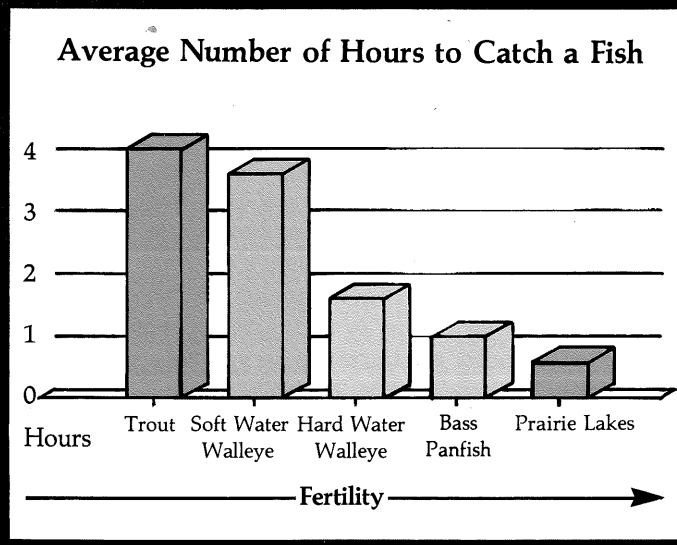
The under-the-ice decomposition of plants in many shallow lakes consumes oxygen, causing winterkill of many game fish. Where good habitat justifies the expense, the DNR, local governments and groups use various aeration systems to keep water oxygenated during the winter.

Regulating the Harvest

Traditional limits have prevented the commercialization of sport fishing and have distributed the catch among the anglers. Many anglers and fisheries managers believe, however, that these limits have not kept the hoard of modern-day anglers from decimating the state's "trophy" fishery.

In theory, a body of water can produce a certain poundage of fish, whether as many small fish or a few big ones. Intense fishing pressure tips the balance toward many small fish as anglers take home the "keepers."

The solution? To raise and stock enough big fish to impress anglers would exceed the DNR's budget and might have disastrous effects on the forage base and other aspects of the environment. Instead, the DNR is embarking in an experimental program of "special regulations."



Traditional regulations are a one-size-fits-all affair — the same rules apply to walleye, for example, in all lakes and rivers in the state. Special regulations, however, are tailor-made for individual lakes and streams to produce particular results.

In some lakes, a "slot limit" requires anglers to return all bass between 12 and 16 inches, preserving the most prolific spawners and most voracious predators (to check the number of sunfish). In other waters, maximum size limits protect fish of a size prized by anglers. Similar size limits and catch-and-release regulations on a few trout streams and walleye lakes aim to keep more big fish available for fishermen.

Gathering Information

Fisheries management is only as good as the information that accompanies it.

Scientific research into population dynamics, habits and life cycles aids fish management. For example, the discovery of a selective poison helped stem the sea lamprey invasion of the Great Lakes.

Other information gathering helps set the course of management. Lake surveys, sample netting and electrofishing help identify problems in a lake or river and enable fish managers to develop a management plan. Follow-up sampling and creel census surveys determine if the management action had the desired effect.

Scientific Management

Because aquatic environments are complex, fish management will remain much like meteorology — an inexact science. But through research and careful monitoring of the fishery, we can conduct a fish management program that depends less on myth and hope, and more on science and clearly expressed goals. In the end, the fishing will be better and the aquatic environment healthier.

Trout and the Stream Environment

Streams are dynamic, their currents fascinating to the anglers who fish moving water. The workings of a river are revealed through the evidence of riffles, eddies and slicks.

Current distinguishes a stream from a lake, and current allows an abundance of life in an environment that other wise would be too small, too shallow, and too devoid of oxygen and food to support many large fish. Let's examine how current and other characteristics of a stream affect fish–particularly trout, because most of DNR's stream management is devoted to trout streams.

Gradient

The gradient, or steepness, of the streambed influences the swiftness of the current. Current continually moves food through the stream system and mixes oxygen into the water. Slack water can be too warm to support trout.Conversely, continuous cascades and rapids make for poor trout habitat (though trout have adapted to swift water better than most fish). Between these extremes, however, trout can flourish, depending on other characteristics of the stream.

Streambed

The makeup of the streambed, or "substrate," depends on the geology of the region and the velocity of the current, which sorts fine materials from coarse. A mixture of boulders, cobble and gravel is best for trout and the invertebrates on which they feed. Silt provides a burrowing medium for some insects, though it provides little else to a trout stream. Sand is nearly lifeless; large amounts of it contributed by erosion cover more desirable bottom types.

The shape and composition of the streambed provide food and cover for trout. Gravel that is gently bathed by current provides spawning areas. Boulders and coarse substrate break the current, providing places a trout can rest while waiting for food to drift by. Deep pools and undercut banks provide refuge during sunny days and low water. Riffles are food factories, and trout often move into them, especially in low light, to actively feed.

Cool Water, Stable Flows and Oxygen

Temperature, more than any other factor, distinguishes trout streams from those inhabited by bass, walleye, northern pike, catfish and other species. Trout need cold water and cannot tolerate temperatures above 75 degrees for long. Because of our relatively warm summers, our best trout streams are fed largely by springs, which average less than 50 degrees and keep the stream cool in summer. The amount of dissolved oxygen in the water (and trout need a lot of it–about five milligrams per liter) depends also on turbulence. Riffles and falls reoxygenate water.

The flow of groundwater is much more constant and reliable than the runoff of rainwater. Consequently, spring-fed streams remain filled during drought and are less prone to flood. Streams that depend solely on surface runoff tend to be "flashy," flooding after a rain and dropping soon after. These extremes stress fish, damage eggs and kill fry.

Alkalinity, Hardness and pH

Though these terms refer to different qualities, they are closely related as they apply to water chemistry. These characteristics influence productivity–not only of trout, but also of invertebrates. Generally, the best trout streams are hard (plenty of dissolved minerals) and alkaline (dissolved calcium carbonate) and have a pH of 7.5 to 9 (not acidic). The most desirable of these qualities are found in spring-fed limestone creeks. By contrast, streams that depend on runoff and flow over volcanic bedrock are less productive because they are generally soft, neutral to slightly acidic, and low in alkalinity.

Food Pyramids

Moving water does not support the abundance of microscopic plant life that still water does. Consequently, compared to lakes, streams depend less on drifting phytoplankton for their food base, and more on leaves, streamside plants and other plant materials that fall or wash in from the nearby land. Productive streams support lush growths of aquatic plants.

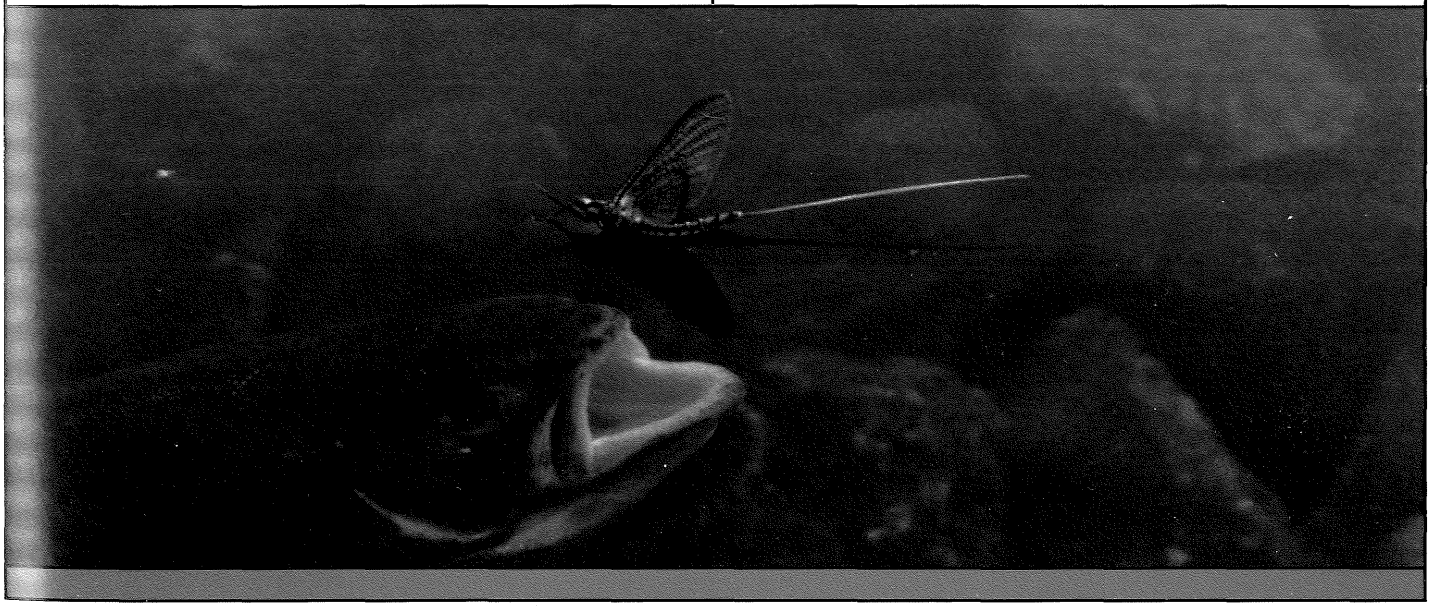
Next in the food pyramid are the plant-eaters, detritus-eaters and scavengers, which range from microscopic invertebrates to four-inch crayfish. Many of these small crustaceans are important foods for trout and forage fish.

Of particular interest to fly-fishers are various aquatic insects–mayflies, caddis flies, stoneflies and several others–that live their early lives amid rocks or burrowed in sediment. Late in their lives, they crawl or swim to the surface and emerge as winged adults to mate and die. Trout feed heavily on the immature and adult forms of these insects. Trout often feed ravenously during an emergence, taking only the form of insect that is "hatching." The angler who can "match the hatch" with an appropriate fly can enjoy terrific fishing at these times.

Some trout streams are rich in invertebrates but lack forage fish. In these waters, trout rely on insects throughout their lives, though some large trout may also prey on other trout. In other streams, where forage fish are abundant, adult trout may feed much more heavily on fish.

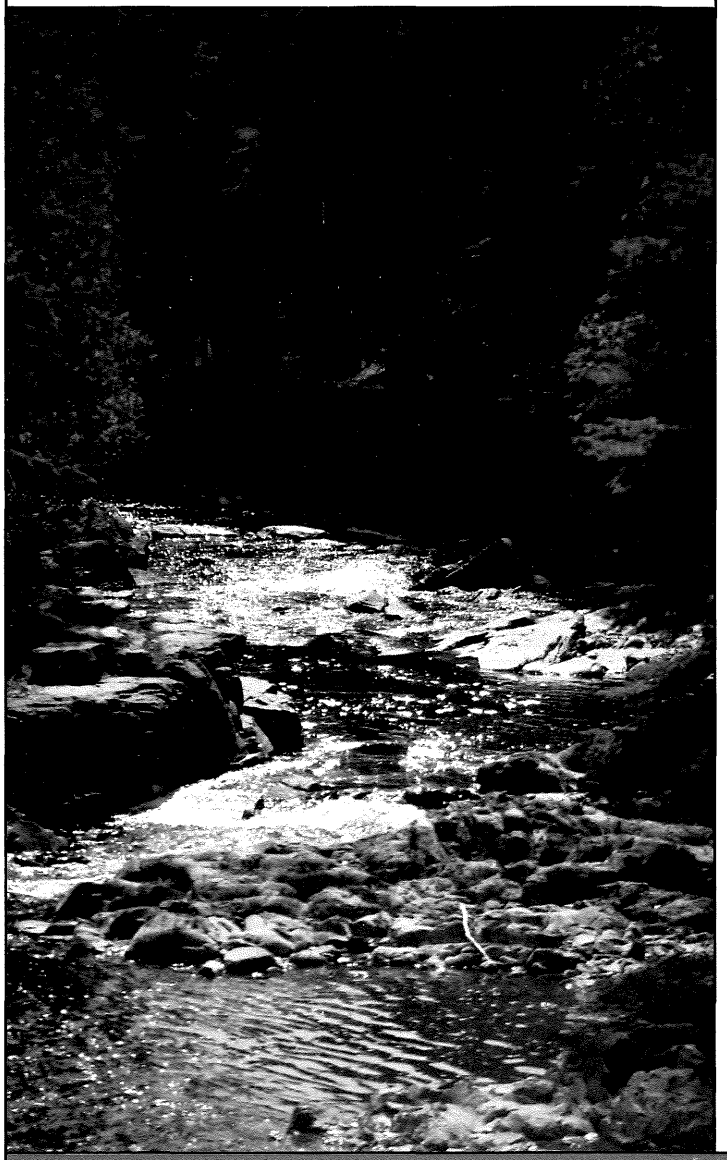
A trout's life in a stream is a precarious balance of energy expended versus energy consumed. Fish that race energetically in pursuit of food would soon die. Instead, trout have evolved to occupy "lies" behind logs, against deep banks, in the upper ends of eddies, or nestled in coarse substrate. There they wait for current to deliver food to them. Large morsels–a four-inch dace, for example–may be worth great effort in chasing. But small items are worth small effort–a gentle rise to the surface or move to the side to sip the insect and then a smooth return to the lie. When a particular insect is emerging in abundance, the efficiency-minded trout may ignore all else to feed exclusively on, for example, emerging mayflies of a particular species. It is then that a stream may seem particularly alive, the insects rising to the surface like bubbles through champagne, and the trout sipping flies from the surface of the water, dimpling the stream as though a gentle rain were falling.

About 600 Minnesota streams totaling nearly 2,000 miles are designated trout waters (though habitat is marginal in some). Most of Minnesota's trout streams lie along the North Shore of Lake Superior or in the rugged hill country of the southeast.



North Shore Streams

North Shore creeks are great scenery but are only fair trout streams. They depend on runoff, so their flows are unstable, surging after a rain, dwindling to a trickle during drought and the winter season. In the summer some stretches get warmer than is best for trout. In their lower reaches, these streams cascade over falls and steep rapids. As pretty as these features may be, they are not conducive to growing trout, which must find niches of quiet water amid the turbulence.



The volcanic bedrock over which they flow has few of the water-soluble minerals that help keep the water alkaline. Consequently, these streams tend to be soft, slightly acidic to neutral, and not very productive. Because they lack spring water, the streams get very cold in winter. In fact, "anchor ice" sometimes forms on the bedrock of the streambed, destroying aquatic life and habitat.

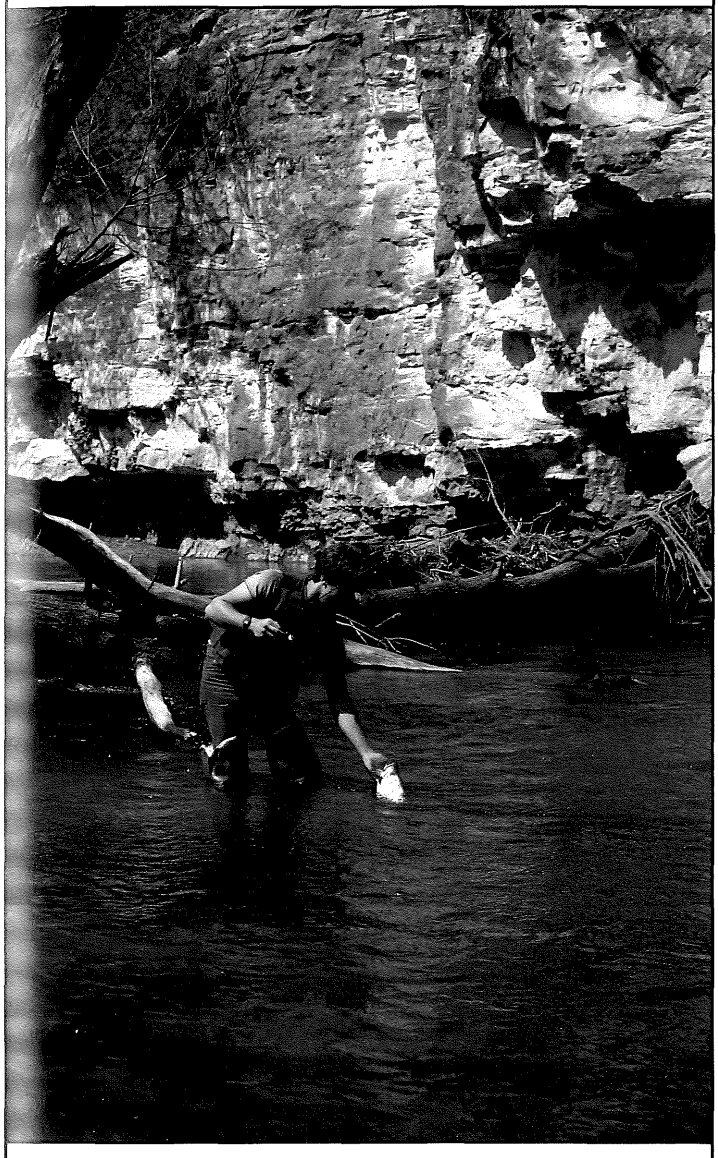
Despite their shortcomings, North Shore streams have two things in their favor. First is their cool, northern, lake-moderated climate. Second is the deep-forest bank cover, which shades the streams and keeps them cool. These influences keep these streams just cool enough to support trout.

Interestingly, trout are not native to the upper reaches of the North Shore streams. Brook trout occupied Lake Superior and ascended the rivers as far as the first barrier falls–usually less than a mile from the lake. Only during the last century have brookies been stocked above the barrier falls.

The DNR stocks brook trout in heavily fished creeks in and near Duluth, though brookies are self-sustaining in many North Shore streams. The smallness of the streams and their low productivity prevent many trout from exceeding a foot in length. As one North Shore fisheries manager noted: "We can raise a lot of small fish." In the deeper water of secluded beaver ponds brookies may reach two pounds. But in the long run, beaver dams do more harm than good, warming the water and contributing to siltation. North Shore trout management includes breaching beaver dams.

In North Shore streams that provide marginal trout habitat, the DNR stocks brown trout, which tolerate warmer water than brookies do. Some large streams are stocked with small steelhead and chinook salmon, which migrate to the lake–the steelhead fry in two to three years, the salmon smolts within days.

Southeast Streams



The streams of southeastern Minnesota are very different from North Shore streams. Most rise from springs and thus are cool in summer. The limestone and alluvial soils in the drainages make the streams hard, nonacidic, alkaline and very productive. Whereas the North Shore streams have relatively few aquatic insects, the southeast streams produce frequent hatches of mayflies, caddis flies and midges–all providing food for trout.

Nonetheless, southeast trout streams do have problems, most related to agriculture. Fence-to-fence grain farming on the uplands and pasturing of the river bottoms contribute to land erosion and sedimentation of the streambeds. This fine sediment covers the gravel runs and riffles that trout need to spawn and invertebrates need to survive. The clearing of shoreline trees takes away the underwater root wads and fallen trees in which trout find cover from current and predators. Finally, many of these streams simply aren't very large, and large trout find little cover. So, while the best of these streams may produce up to 300 pounds of fish per acre–excellent production by any measure–18-inchers may be scarce except as figments of the imagination.

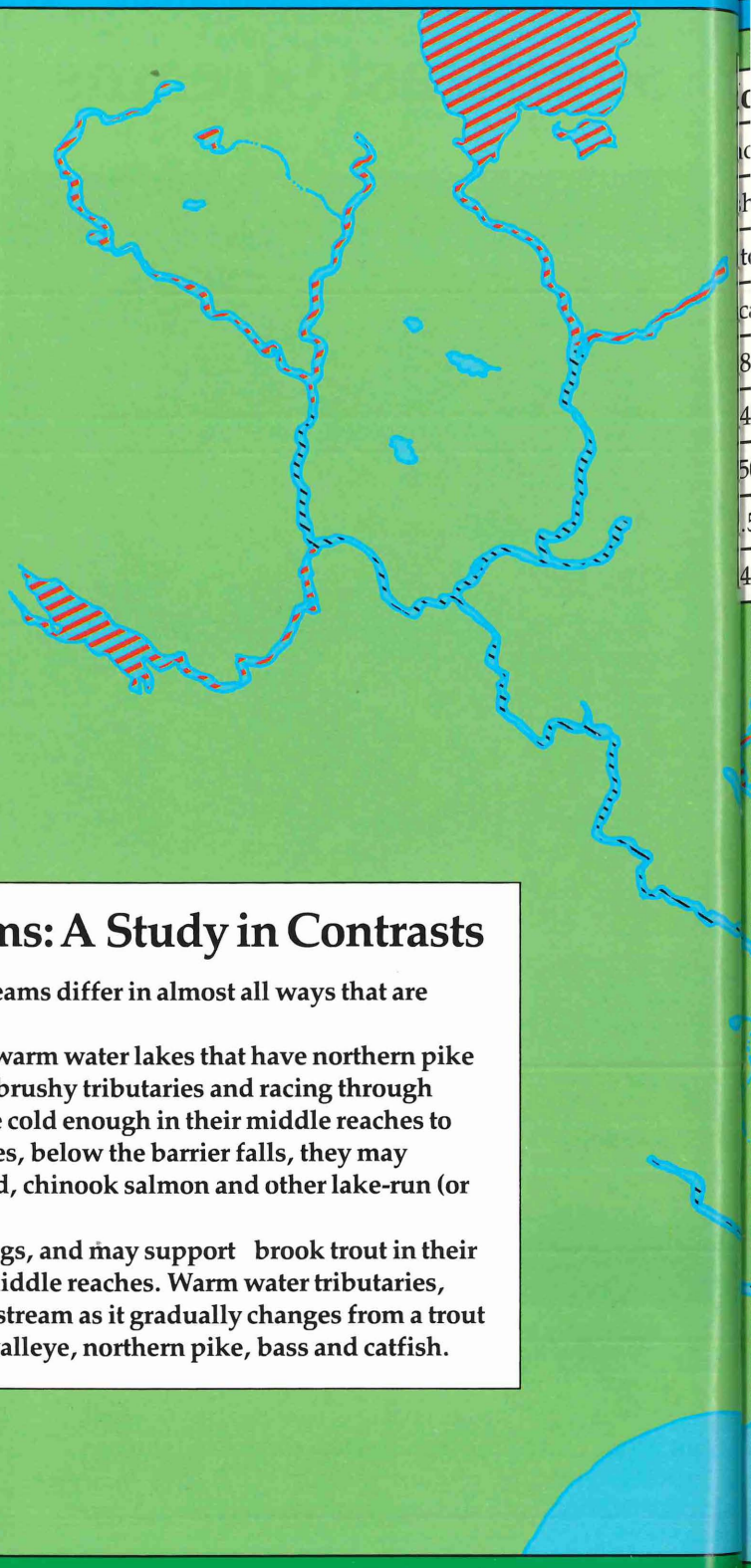
Because the chemistry and productivity of these streams are good, trout respond well to some kinds of habitat improvement. For example, the use of planks and boulders to build artificial overhanging banks increases big-fish cover, as does the placement of boulders in the channel. Riprap prevents bank erosion. Wing dams and other current deflectors keep silt from key areas.

Brown trout are the trout best suited to the southeast streams. In the best of these rivers, such as Trout Run (in Winona and Fillmore counties), browns are self-sustaining. In other streams, such as the South Branch of the Whitewater, natural reproduction is augmented with stocking. In a few streams, spawning habitat is extremely limited, and the trout fishery is maintained entirely by stocking. Most people fishing these streams would regard a 14-inch brown as large, though some trout occasionally exceed eight pounds.

Some small southeast tributaries support wild brook trout; other streams are stocked with brookies. Some strains of rainbow trout have been tried in these creeks. Unfortunately, rainbows tend to migrate to larger, less suitable water so success with this species has been limited.

Other Trout Streams

Hundreds of other streams course Minnesota's woods and farmlands. They range from the Straight River near Park Rapids, with its rich silt beds, profuse mayfly hatches and large wild brown trout, to the marginal soft-water creeks of Pine County, some of which maintain trout only through stocking. The quality of these streams depends on suitable streambed geology, adequate groundwater, and compatible land use in the watershed. A good trout stream is a lucky mix of these ingredients that can be improved only within the limits of basic productivity.



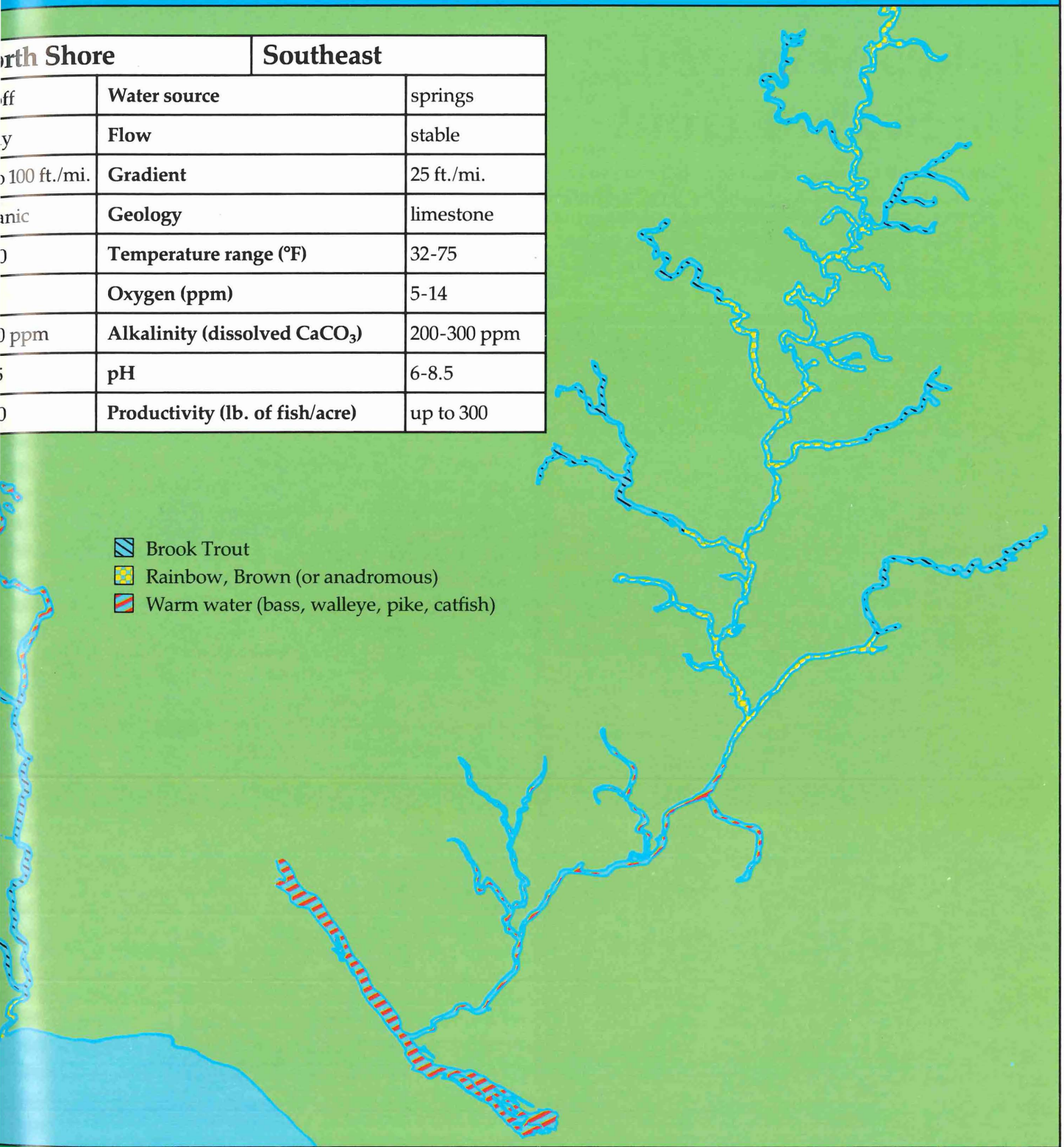
Minnesota Trout Streams: A Study in Contrasts

North Shore streams and southeast streams differ in almost all ways that are important to trout.

Many North Shore streams flow from warm water lakes that have northern pike and walleye populations. Joining small, brushy tributaries and racing through cool, shaded gorges, these creeks become cold enough in their middle reaches to support brook trout. In their lower reaches, below the barrier falls, they may support resident trout as well as steelhead, chinook salmon and other lake-run (or "anadromous") species.

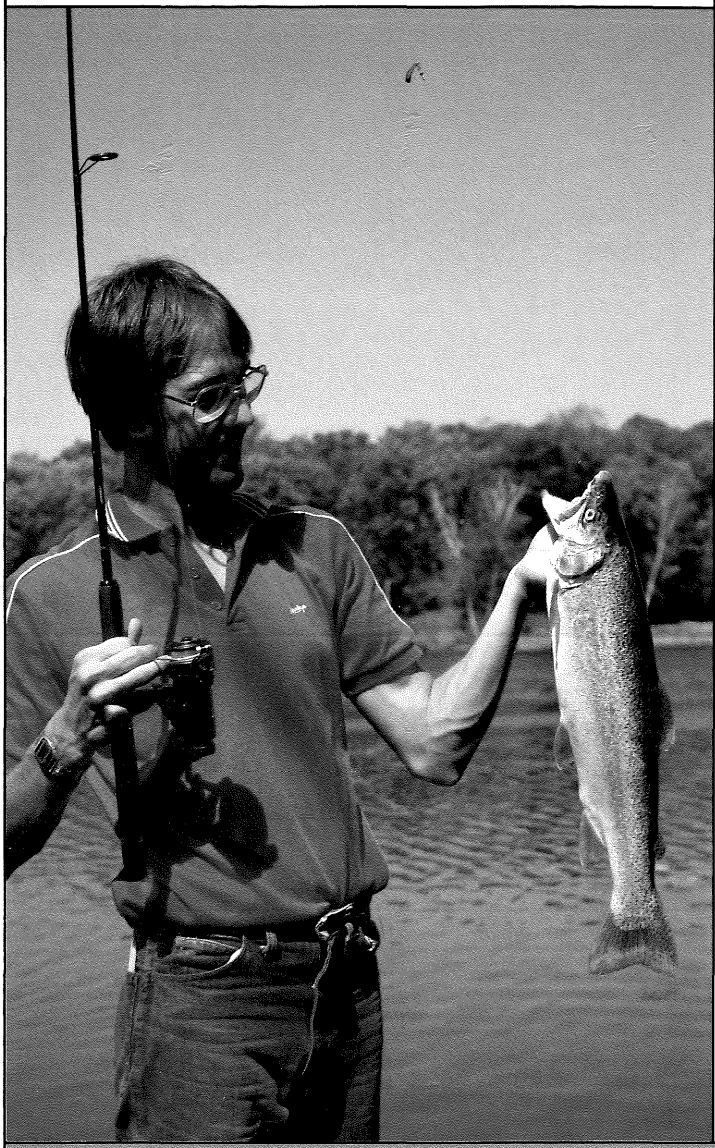
Southeast trout streams rise from springs, and may support brook trout in their headwaters. Brown trout prevail in the middle reaches. Warm water tributaries, dependent on runoff, may join the main stream as it gradually changes from a trout stream to a warm water river harboring walleye, northern pike, bass and catfish.

rth Shore	Southeast	
ff	**Water source**	springs
y	**Flow**	stable
100 ft./mi.	**Gradient**	25 ft./mi.
anic	**Geology**	limestone
0	**Temperature range (°F)**	32-75
	Oxygen (ppm)	5-14
0 ppm	**Alkalinity (dissolved $CaCO_3$)**	200-300 ppm
5	**pH**	6-8.5
0	**Productivity (lb. of fish/acre)**	up to 300



Lakes Managed For Stream Trout

Though brook, brown and rainbow trout evolved to breed and live in streams, they grow bigger when they are put into lakes. So, the DNR stocks stream trout in about 160 lakes to give anglers a chance to catch trophy trout–brookies up to six pounds, rainbows up to 10 and browns as large as 16.

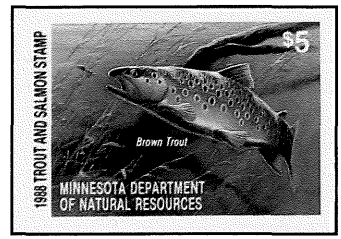


In selecting lakes for stream trout, the DNR looks for lakes that are cold, well-oxygenated and free of pollutants. Ideally, the basins have no inlets or outlets that would allow stocked trout to leave or other fish to enter the lake and eat the trout or compete with them for food. Because of the potential for competition between species, native fish are removed before trout are stocked. Consequently, only lakes with undesirable fish populations are chosen for "rehabilitation." Stocking continues regularly because rainbow and brown trout require current-washed gravel to spawn and can't reproduce in lakes. Brook trout are better adapted to lakes and can spawn where an upwelling of spring water in the lakebed washes the eggs, however, significant natural reproduction is rare.

Some large lakes are managed for both stream trout and native lake trout. Other lakes are "two-story" fisheries–the shallows occupied by warm water game fish (such as walleye, bass and sunfish), and the depths used by stream trout.

In addition to brook, brown and rainbow trout, the DNR stocks splake–a cross between the male brookie and female lake trout. Splake grow faster than lakers and bigger than brook trout. They are popular because they taste good and are easy to catch.

Anglers, ages 16 to 65 must buy a trout stamp to fish on Minnesota's designated trout streams and lakes, including Lake Superior. Funds from stamp sales pay for habitat improvement, raising and stocking trout, and evaluating management actions through electrofishing, creel censuses and other methods.



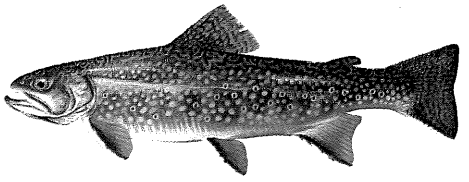
Gary Moss

Minnesota Trout

BROOK TROUT: The only native Minnesota trout species, the brook trout originally inhabited Lake Superior and many small cold lakes and streams throughout the state. Now common in the upper reaches of North Shore streams, it also is found in some small creeks in southeastern Minnesota and scattered waters elsewhere in the state.

The brook trout takes a lure or bait more readily than the rainbow or brown trout. It is protected less by any innate wariness than the fact that it typically inhabits tiny alder-choked creeks that are difficult to fish.

Brook trout from streams have pale markings on a dark green background. The back is covered with wormlike marks. Lake Superior fish are more silvery with less distinct markings. In both stream and lake fish, the tail is nearly square, and the leading edge of each lower fin often has a white margin. The brook trout rarely exceeds a pound in small streams. Lakes produce larger fish.

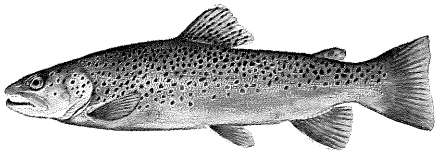


BROWN TROUT: Introduced from Europe to much of the United States during the late 1800s, the brown trout has adapted well, tolerating warmer water than the native brookie and supplanting it in many waters throughout the state.

Young brown trout feed on aquatic insects and other invertebrates. As browns exceed a foot in length, they seek chubs, dace and other small fish.

Brown trout are warier and harder to catch than brook trout and can live in streams too warm for brookies. Browns also grow faster and larger. Consequently, they often are stocked in streams that provide marginal trout habitat or where fishing pressure is heavy.

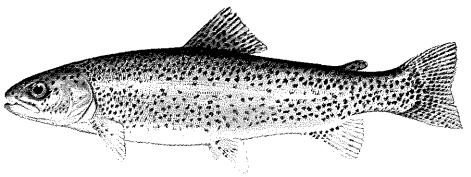
The brown spawns in the fall and occasionally exceeds 10 pounds, even in small streams. It has dark spots and a few red spots on an olive or brown background. Its square tail has few or no spots.



RAINBOW TROUT: The rainbow trout, stocked in Minnesota a century ago, has become particularly important in Lake Superior and North Shore streams. Fish living in the lake and moving into streams to spawn are known as "steelheads." They ascend tributaries in the fall and spring, spawn in the spring, and swim downstream to the lake. Young trout remain in the streams for up to three years and then enter the big waters of Lake Superior, where they feed on terrestrial insects, various other invertebrates, and small fish.

Considered neither as wary as the brown or as gullible as a brook trout, the rainbow is prized as a game fish because it fights hard, frequently leaping when hooked.

Rainbows stocked in small lakes may exceed 10 pounds; stream fish rarely grow larger than three. The rainbow has dark spots on a light background. Its back is olive and its side carries a pink stripe. The tail is covered with small black spots. The body of a lake-run fish is silvery.



Special Regulations

Some trout stream regulations are "special" in that they are tailored to individual trout streams. These regulations can also reduce the number of fish anglers can take home. Some stretches of stream, in fact, may be designated "catch-and-release," or "no-kill," areas. In other sections, "slot limits" may be used to protect a certain size of fish (a slot of 12 to 16 inches, for example). Thus, regulations can manipulate trout populations to produce fewer small trout and more trophies. Slot limits also can allow anglers to keep small fish and a few very large fish while protecting faster-growing intermediate sizes.

Many anglers practice catch-and-release even when regulations don't require it. They reason, as one well-known fisherman remarked, that a large trout is too valuable to be caught only once. Trophy-sized trout **can** be caught and enjoyed again and again by different anglers.

Catch-and-release, special regulations and the move to a wild-trout fishery in some streams has done more than just improve fishing. Eliminating the stocking of some streams has saved money. Wild-trout management also has led to a healthier fishery–one that can maintain itself, even during times of neglect or tight money.

Despite success with wild-trout fisheries and catch-and-release angling, there have been failures as well. Some streams are too infertile to produce large trout–no matter how long they remain in the stream. In these instances, catch-and-release may have little effect. In other cases, a slot limit of the wrong sizes has put too much pressure on small fish, leaving too few to grow large and produce an acceptable number of trophies. Because of differences in the physical characteristics of streams, the results on one river cannot be simply transferred to another.

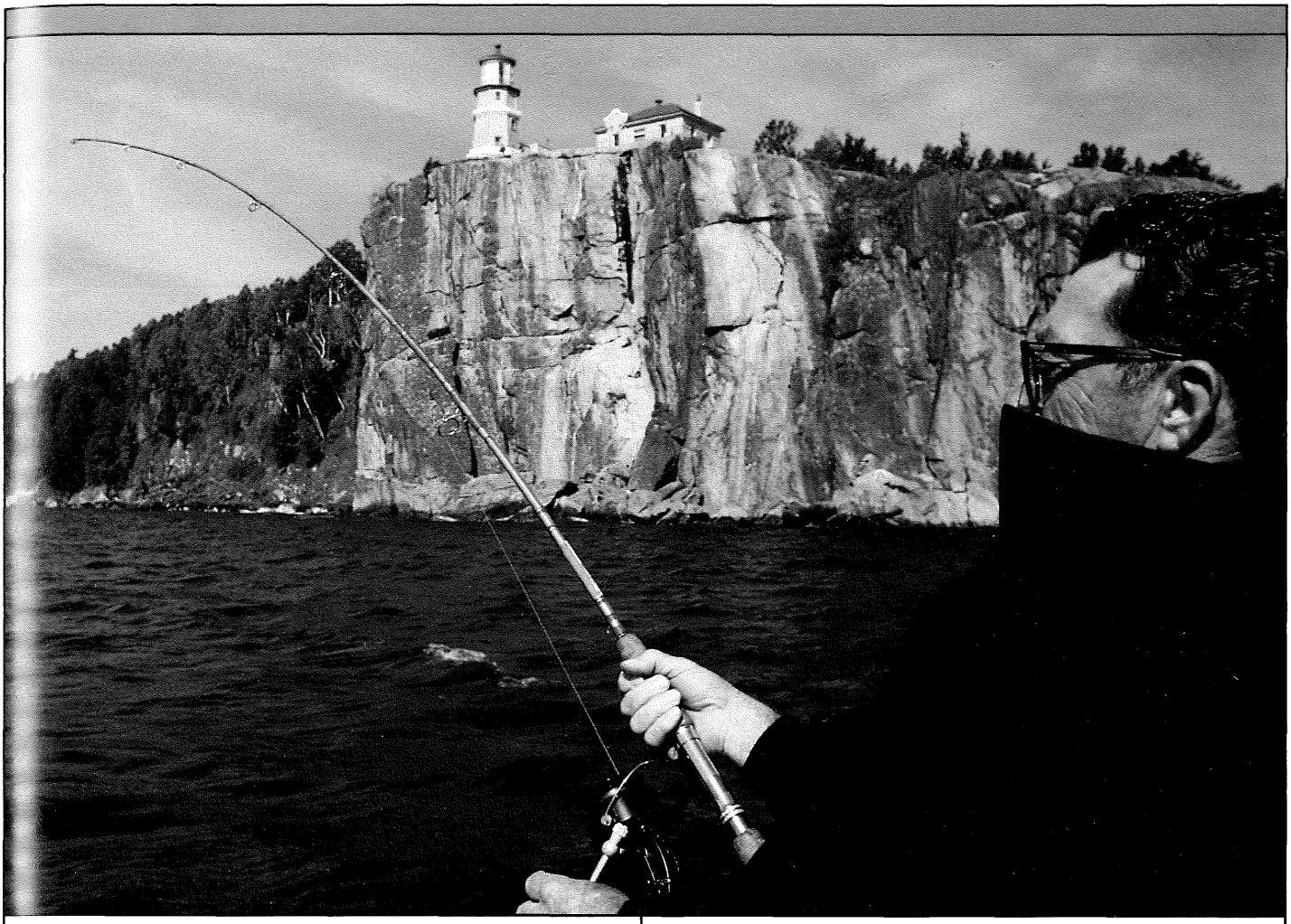
The success of any program depends first on setting clear, realistic objectives (for example, increasing the number of trout larger than 13 inches). Then, regulations must be carefully tailored to the stream on which they will be applied. Finally, the stream must be surveyed by electrofishing or creel censuses to determine if the regulations are working as planned.

Minnesota has moved toward wild-trout management on several streams on the North Shore and in the southeast, which depend solely on natural reproduction. The DNR has begun experimenting with catch-and-release regulations and various slot limits on a few selected streams to improve the quality of Minnesota's stream-trout fishing and to offer anglers another fishing alternative. Nonetheless, wild trout and restrictive regulations will only be a part of the state's diverse approach to trout management. The trout-stocking program will continue to be important to Minnesota's fisheries management. The program will provide trout in marginal waters and give anglers, who don't care about the thrill of catching a wild trout, a chance to take home a trout.

Turn in Poachers

Help stop poaching of Minnesota's fish and wildlife. Report violations to TIP (Turn In Poachers). You don't have to give your name. If the information leads to an arrest, you may receive a cash reward.

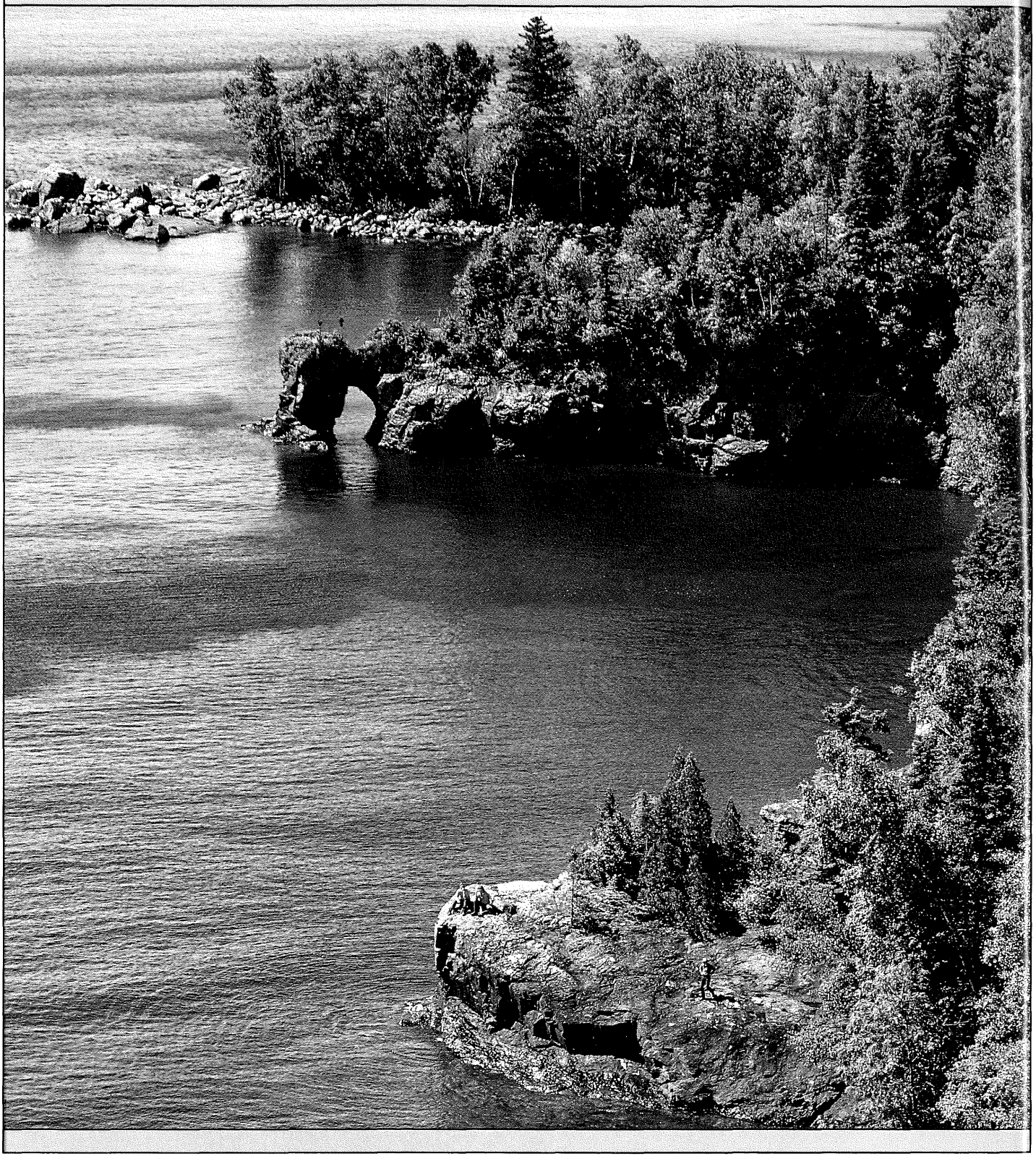
Call TIP
Toll-free 800-652-9093
Or telephone your local conservation officer



Lake Superior

An 1800s Lake Superior commercial fisherman fishing today would be astonished at the abundance of fin-clipped lake trout and lack of lake herring, whitefish and lake sturgeon. He would look in vain for large trout–20-pound lakers and five-pound migratory brook trout and be surprised by the many unfamiliar fish in his nets: steelhead trout and chinook, coho and pink salmon from the Pacific coast; eel-like sea lamprey trailing from the sides of some of his catch; rainbow smelt from the Atlantic Ocean; European brown trout and the East Coast Atlantic salmon. He would find that Lake Superior, despite its great size and wild character, is much different from the lake of a century ago.

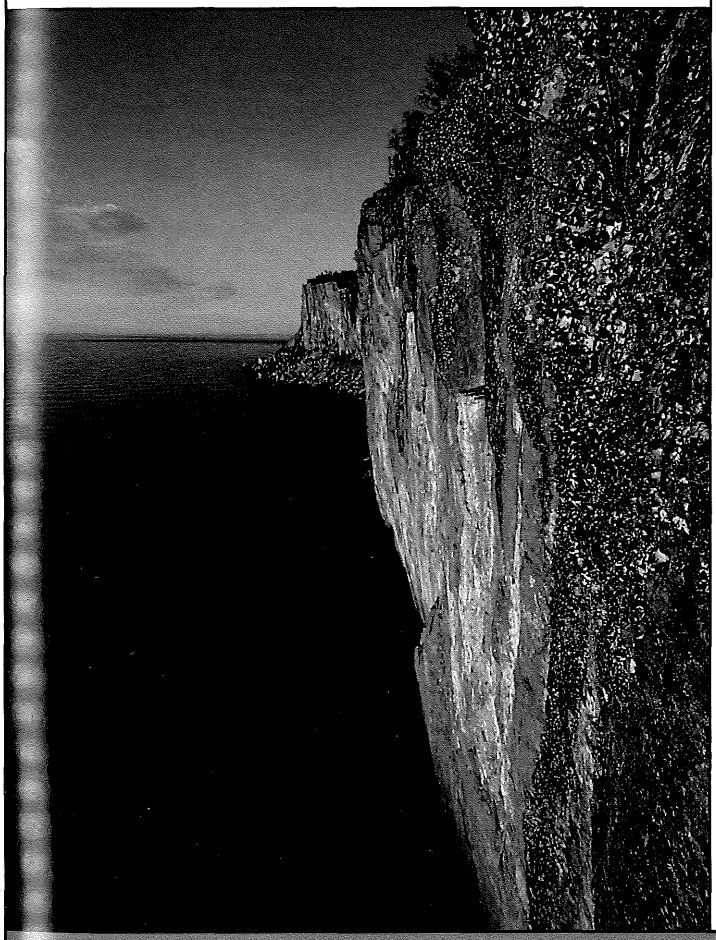
The changes in Lake Superior can be traced to its sensitivity to nonnative species. The sea lamprey decimated lake trout and other predatory fish. Smelt have replaced native lake herring. On the other hand, introduction of nonnative trout and salmon have created new opportunities for anglers. Moreover, scientific research and aggressive management are restoring the native lake trout. Fishermen now troll from boats, cast from shore and crowd the tributary streams to catch species that were scarce or absent 20 years ago. Within the last decade, fishing pressure has more than doubled. What some nonnative species have taken away, others have given back.



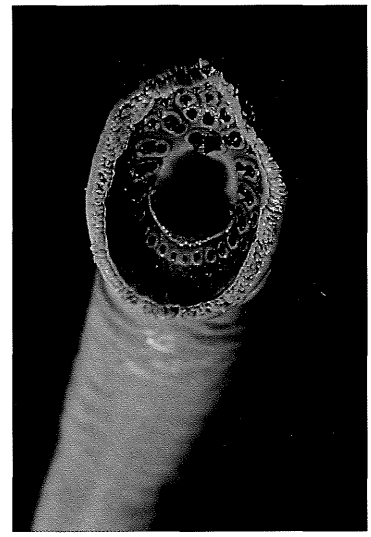
The Lake

Superior is the largest, deepest and coldest of all the Great Lakes. It is "oligotrophic"–that is, cold, infertile, rocky, well oxygenated, and weed free. Because of its cold, depth and infertility, Lake Superior does not produce a great density of fish. Scientists have estimated that before settlement Lake Superior produced only about half the weight of fish per acre that Lake Michigan did.

This low productivity is particularly true of Minnesota's 1.4 million acres (which constitute about seven percent of the lake's total area). Minnesota's waters are cold, and the shoreline plunges to 400-foot depths less than two miles from shore. Minnesota lacks the broad, productive shallows that many fish depend on for spawning and feeding.



Great Lakes fisheries evolved in isolation since glaciers receded at the end of the last Ice Age, about 11,000 years ago. Niagara Falls blocked the migration of fish from the Atlantic Ocean to the upper lakes. In Superior, the lake trout occupied the summit of the food pyramid. Other large-fish species were the lake sturgeon, lake whitefish and lake herring. Brook trout lived in the lake and ascended North Shore streams as far as the first major waterfalls.



Though early unregulated sport and commercial fishing undoubtedly reduced the number and size of fish in this infertile fishery, Superior's real problems began in the 1920s, when changes to the Welland Canal allowed sea lamprey–parasitic eel-like creatures–to bypass Niagara Falls and invade the Great Lakes. Lampreys latched onto the sides of their victims, sucking blood and other fluids, often killing them. Lake trout grow and develop slowly, females requiring eight years or more to reach sexual maturity. Consequently, many fish succumbed to lamprey before they reproduced. A lamprey was first reported in Lake Superior in 1938. Lampreys soon reached such numbers that the commercial lake trout harvest plummeted 90 percent during the 1950s. Rainbow trout, whitefish and burbot also fell victim to the parasite.

With the near loss of the predatory lake trout, a small Atlantic Ocean native called the rainbow smelt (which accidentally escaped into the Great Lakes) exploded in numbers.

Thus, by the 1960s, Lake Superior was an immense system badly out of balance. There were too many smelt and too few predators. Few game fish swam Superior's waters.

The Remedy

In 1955, the Great Lakes Fisheries Commission was formed in a treaty with Canada. The Commission is charged with overseeing lamprey control and coordinating research and management efforts in the Great Lakes. The Commission's strategic plan coordinates lake efforts among states, provinces and federal (U.S. and Canada) agencies.

In 1957, U.S. Fish and Wildlife researchers tested a group of toxicants that seemed to kill only lamprey. The discovery was a breakthrough in the restoration of Lake Superior and the other Great Lakes. One of these chemicals, called TFM, was applied to streams, where it killed newly hatched lamprey larvae. Lamprey numbers soon dropped 90 percent. Continued use of TFM kept the parasite in check. Consequently, fisheries managers in Minnesota, Ontario, Wisconsin and Michigan could reintroduce large predators to make use of the plentiful smelt and once again provide sport fishing in Lake Superior.

The highest priority has been the restoration of the lake trout. Minnesota closed commercial and sport fishing for the laker in 1962. Sport fishing reopened a few years later, but netting continues to be tightly regulated and is done primarily to assess trout numbers and reproduction, and to monitor the prevalence of lamprey scars. Since 1962, the Minnesota Department of Natural Resources (DNR) and the U.S. Fish and Wildlife Service have planted an average of more than 300,000 six-inch lakers along the North Shore each year. The results, though slow in coming, have been heartening. In 1976, fisheries workers netted an average of only 16 young lake trout per 1,000 feet of gill net. Ten years later, workers lifted 41 lakers per 1,000 feet of gill net–250 percent increase. Furthermore, of the young lakers taken during assessments in 1976, less than two percent were "wild" fish–the result of natural reproduction. In 1986, 19 percent were wild. The proportion of wild fish is even higher in Michigan and Wisconsin waters.

Another important goal of Minnesota's fisheries program is to maintain the prized steelhead through stocking and natural reproduction. In a typical year, the DNR may stock more than three million steelhead fry

above the barrier falls of some North Shore streams. To make more water available to migrating steelhead and increase natural reproduction, the DNR has modified some waterfalls to allow the fish to pass upstream. By removing just a few strategic barriers on such rivers as the Knife, the DNR has added more than 60 miles of stream, doubling the amount of water available to spawning steelhead.

The introduction of Pacific salmon also has been an important part of restoring balance and good fishing to Lake Superior. During the late 1960s, Michigan led Great Lakes states in stocking coho and, later, chinook salmon, two West Coast transplants. Minnesota, too, began stocking coho but soon switched to the chinook, which grows larger and returns to streams earlier in the fall, when more people are willing to fish for them. The chinook program, though it provides an exciting sport fish, will remain secondary to the restoration of the native laker and maintenance of the steelhead.

Fisheries managers have tried to determine if these three species compete for forage. No such competition has been apparent, perhaps because lakers and steelhead are limited more by reproduction than by lack of food or space. Since chinooks apparently do not naturally reproduce in Minnesota's North Shore tributaries, the salmon population can be controlled by

changing stocking rates. In the meantime, however, the chinook shares a role with the laker and steelhead in restoring the balance of predators and prey and providing sport fishing.

Other trout are stocked in lesser numbers. One of the most interesting is the Atlantic salmon, a trout native to the Atlantic coasts of North America and Europe, where it exists in sea-run and "landlocked" forms. The Atlantic salmon readily takes flies and other artificial lures. As its Latin name (*Salmo salar*) indicates, it leaps when hooked and is a tremendous battler. The Atlantic's sporting qualities were recognized early by Minnesotans. More than a century ago it was stocked–unsuccessfully–in lakes and streams in the southern part of the state. Fish managers hope its introduction to Superior will be more successful. Eventually, they plan to stock up to 100,000 fingerlings a year so that the Atlantic eventually will become an important predator and sport fish. Unlike the Pacific salmon, the Atlantic salmon may make several spawning runs during its life and thus will be more frequently available to stream anglers.

Unfinished Business

Superior still is not "fixed." Fish managers continue to be vexed by fluctuations in the forage base. During the late 1970s, for example, the number of smelt in the lake fell 98 percent. Meanwhile, the number of lake herring and chubs have rebounded rapidly. Fish managers hope to keep the nonnative smelt population low by stocking salmon and trout and to allow the native herring and chubs to increase. Ultimately, they hope to avoid boom-and-bust cycles.

Also frustrating is the slow recovery of the lake trout. Possible reasons include an insufficient number of large brood fish and continued lamprey predation. Fish managers are annually examining the lake trout program to determine if the stocking sites and the ages and strains of stocked fish will produce naturally reproducing lakers.

The lamprey continues to kill large fish. The use of TFM remains necessary to keep the lamprey from rebounding. Some biologists are concerned that use of TFM in the long run will favor stocks of lamprey that spawn near rivers' mouths or in the open lake, beyond the reach of the lampricide. With the hope of eventually relying less on TFM, fish managers are trying other methods of lamprey control–barrier dams, the release of sterile males to interfere with spawning, and the development of attractants and repellents.

The cost of fish management in Lake Superior is borne partly by funds raised from the sale of Minnesota trout stamps, which all anglers between 16 and 65 must have to fish Lake Superior or other designated trout waters. Managers and anglers are optimistic that Lake Superior will respond to aggressive fisheries management. With lake trout and herring showing signs of recovery, and predators and prey in better balance, Lake Superior is healthier and is providing better and more varied fishing than it has in years.

Species	Catch rates, average size	Percent of total catch
Lake Trout	8 hrs./fish (boat) 16 hrs./fish (shore) Average size: 3.0 lb.	53.6
Coho	20 hrs./fish (boat) Few caught from shore Average size: 2.6 lb.	18.6
Rainbow (steelhead)	30 hrs./fish (boat) 8.4 hrs./fish (shore and stream) Average size: 3.4 lb.	13.6
Chinook	30 hrs./fish (boat) 15 hrs./fish (shore and stream) Average size: 8.2 lb.	12.3
Atlantic Salmon	100 hrs./fish (boat and stream)	1.9
Brown Trout	100 hrs./fish (boat and stream)	1.9
Pink Salmon	100 hrs./fish (boat and stream)	1.9

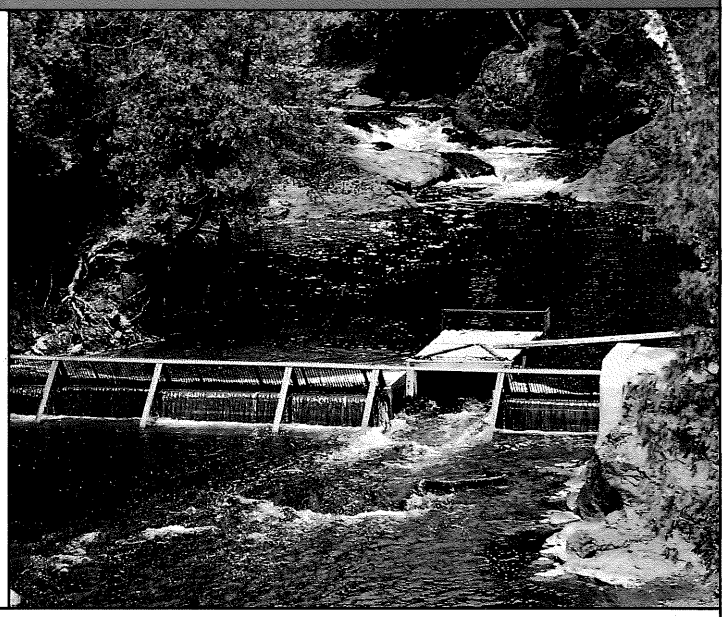
Data: Minnesota Department of Natural Resources, 1986

Anglers spent nearly 300,000 hours fishing from boats in Minnesota waters of Lake Superior in 1986, a representative year. They spent more than 120,000 hours casting from shore and fishing North Shore streams below the barrier falls. In all, they caught nearly 45,000 fish, an average of one fish every nine hours.

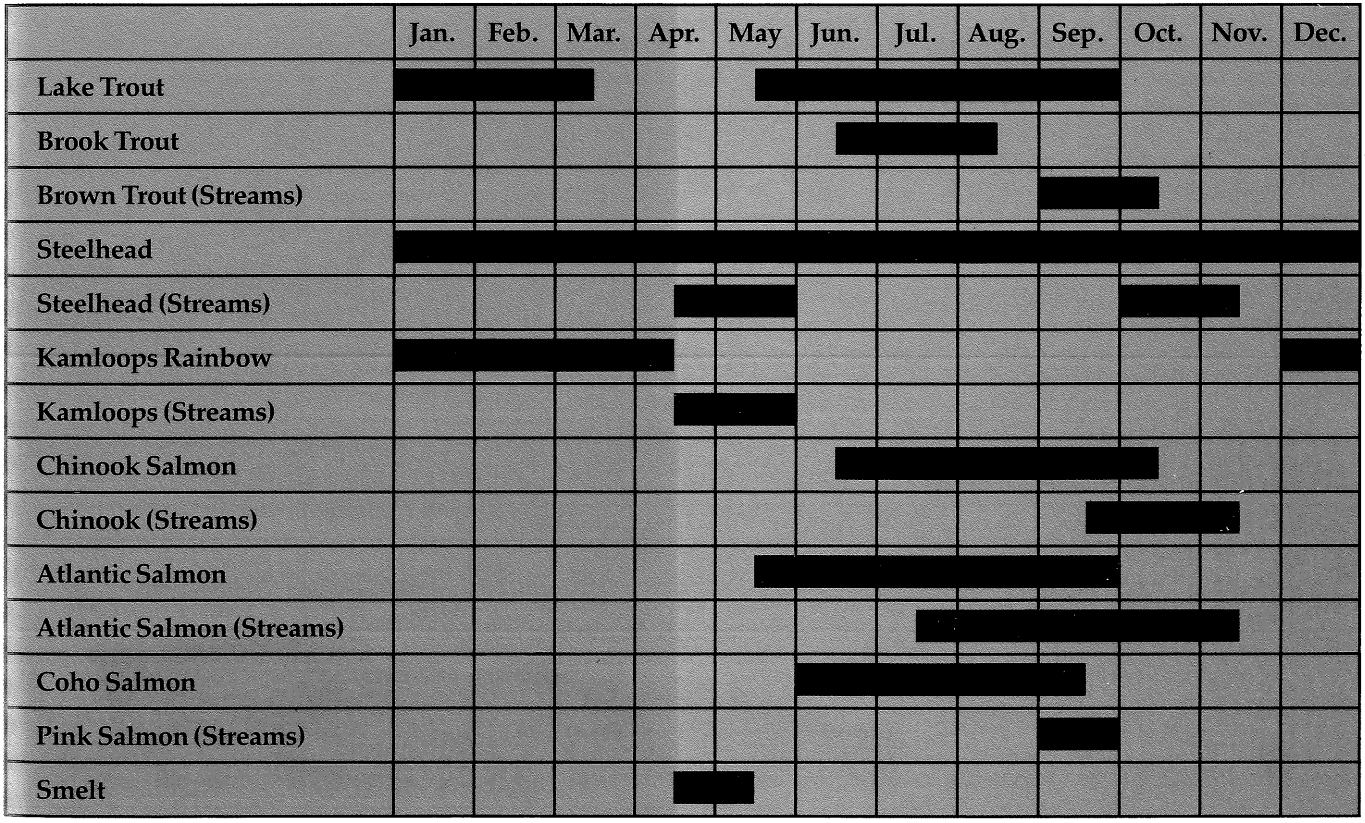
Unfinished Business cont.

The North Shore is laced with small, steep, short streams. Nearly all have high falls that block the upstream migration of fish from Lake Superior. Consequently, stream-spawning steelhead, Atlantic salmon and chinook salmon, have little water available for reproduction.

To solve this problem, the DNR built the French River hatchery. Here, fish entering the French River are captured and stripped of their eggs and milt. The eggs are fertilized and hatched. In this way, the DNR maintains a supply of steelhead, Atlantic salmon and chinook salmon for stocking.



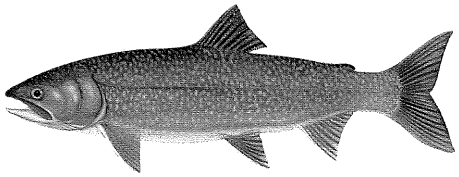
Lake Superior Fishing Calendar



Lake Superior Fish

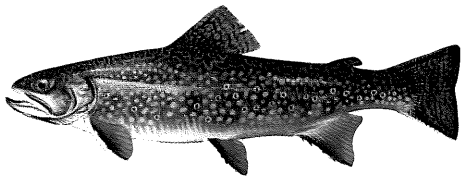
LAKE TROUT: The lake trout is the state's largest trout. Though Superior has yielded fish larger than 40 pounds, the typical laker weighs about three pounds. They don't tolerate water warmer than 65 degrees and so are found only in deep, well-oxygenated lakes. In Superior, lakers are found as deep as 600 feet. They spawn on rock rubble or reefs in late fall. Adults normally eat lake herring, smelt, sculpins and other small fish, as well as freshwater shrimp, terrestrial insects blown into the lake, and other invertebrates. Stocking and rehabilitation of the lake trout may have suffered in the past because the natural, local strains of trout for planting in particular areas of the lake were not available as hatchery stock.

Lake trout, which belong to a group of trout known as char, have pale markings on a gray, green or olive background. The tail is deeply forked, and the leading edge of each lower fin often has a white margin.



BROOK TROUT: Minnesota's other native char has swum the waters of Lake Superior and the lower reaches of the North Shore streams since the Ice Age, though it has never been as abundant as the lake trout. During the last several decades, it has been stocked heavily in the North Shore streams above the barrier falls. Brookies spawn in streams each fall. These soft-water creeks are small and infertile; consequently the brook trout here average less than 10 inches. Lake-run fish, known as "coasters," grow larger, though these are scarce today.

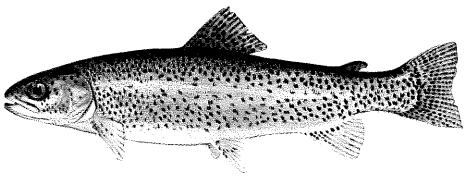
Brook trout from streams have pale markings on a dark green background. The back is covered with wormlike marks. Lake-run fish are more silvery and have less distinct markings. In both stream and lake fish, the tail is nearly square, and the leading edge of each lower fin often has a white margin.



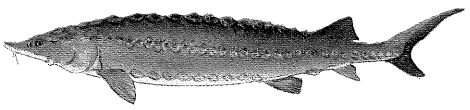
RAINBOW TROUT: The rainbow, a West Coast native, was stocked in Lake Superior tributaries a century ago. Lake-run fish, which grow rapidly and may reach 12 pounds, are called steelhead for the silvery luster they acquire living in open water. They enter more than 50 North Shore streams in the late fall and spring, spawn in the spring and then return to the lake. Young trout remain in the streams for up to three years and then enter the big waters of Lake Superior, where they feed on terrestrial insects, various other invertebrates, and small fish.

The tail of the rainbow is covered with small black spots. The inside of the mouth is entirely white. The anal fin has 12 rays or fewer. The body of a lake-run fish is silvery; stream fish are darker with the characteristic rainbow stripe.

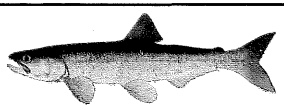
Another variety of lake-run rainbow, the Kamloops, recently has been introduced from British Columbia. The Kamloops gathers at the rivers' mouths in midwinter, much earlier than the more familiar strain of steelhead, and extends the fishing season for shore casters. The Kamloops rainbow is stouter than the other variety of steelhead and retains the pink strip and black spots along the sides and back that are characteristic of stream trout.



LAKE STURGEON: Minnesota's largest fish, which occasionally exceeded 100 pounds, once swam the waters of Lake Superior, particularly the shallow St. Louis Bay. Lake sturgeon infuriated commercial fishermen by ripping their nets. The fish were commonly killed and thrown away. Later, the sturgeon was sought for its caviar, flesh, and air bladder (which was used in making a semi-transparent gelatin called isinglass). Overfishing greatly reduced its numbers. It is too early to evaluate the effects of a recently begun rehabilitation program on this long-lived fish.



RAINBOW SMELT: Released accidentally into Lake Michigan, the smelt spread through the Great Lakes during the early 1900s, reaching Minnesota waters in the 1940s. They since have become an important forage and commercial fish, though their numbers have declined from peaks in the 1970s.

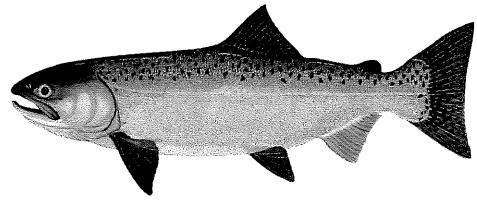


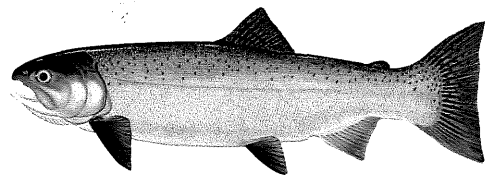
PACIFIC SALMON: Three species of Pacific salmon have been introduced recently to Lake Superior. All feed in the open waters of Lake Superior until they reach sexual maturity. They ascend rivers in the fall to spawn and then, inevitably, die.

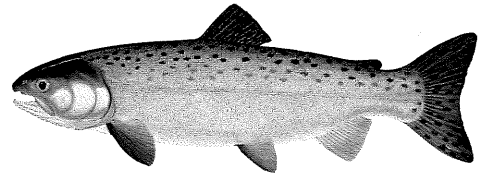
The chinook is the largest of the Pacific salmon and for that reason is the one most prized by anglers. Chinook salmon live in the lake and feed on fish, terrestrial insects and other invertebrates for three to five years, growing to 15 pounds or more, and then begin returning to the North Shore streams in late August. Most fish die by November. By the time the chinook enters the stream, its digestive system has atrophied, and it does not eat. But it will strike at fish and lures, apparently out of territorial aggression or a lingering feeding instinct. Chinook have a wide tail with spots on the upper and lower lobes. The gums and inside of the mouth are gray or black. Chinook have 15 to 19 rays in the anal fin and 130 to 165 lateral-line scales. The lower jaw ends in a sharp point.

The coho is another Pacific salmon that ascends rivers to spawn and die. Though no longer stocked by Minnesota, which has favored the larger chinook, the coho migrates into Minnesota waters from other areas in Lake Superior, where it reproduces naturally and is self-sustaining. Adult cohos average about three pounds. Though the inside of the coho's mouth is gray or black, the gums are white, unlike the chinook's. The tail is less broad than the chinook's, and any tail spots are on the upper lobe. The anal fin has 12 to 15 rays, the lower jaw is blunt, and lateral-line scales total 121 to 148.

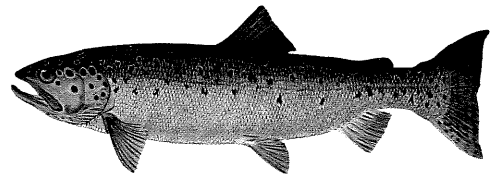
The smallest of the three Pacific salmon is the pink, or "humpback." It was accidentally introduced by Canadian fisheries managers in the mid-1950s and quickly proliferated. During their two or three years in the lake, they eat mostly invertebrates. Mature pinks weigh about 1-½ pounds. Pinks have a few large, elongated black spots scattered over their tails. A breeding male develops a large hump in front of its dorsal fin. Scales are very small (147 to 205 along the lateral line).





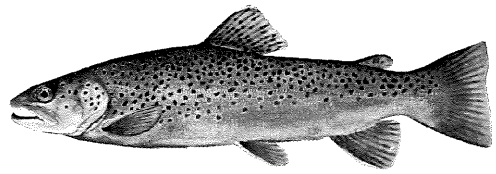


ATLANTIC SALMON: Atlantic salmon are an East Coast species of trout, introduced recently to Lake Superior. They ascend rivers in late summer and early fall to spawn and then return to the lake. Eggs hatch the following spring. The fish caught by anglers average about three pounds but occasionally exceed 10. The Atlantic has silvery flanks and a blue or brown back with X-shaped markings. The base of the tail is narrow. The tail itself is slightly forked and has two to five spots. The anal fin is short (eight to 11 rays); 109 to 121 scales lie along the lateral line. Two to five large round spots mark the cheeks.

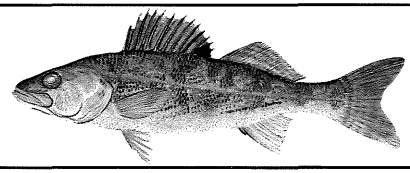


BROWN TROUT: Though they occassionally swim Minnesota's portion of Lake Superior, brown trout are more common along the South Shore. They also occupy North Shore streams, above and below the barrier falls. Brown trout from Europe were introduced to Minnesota and much of the United States during the late 1800s.

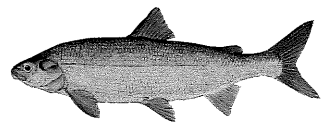
A lake-run brown has X-shaped spots along its back and sides, and few or no spots on its square tail. The inside of its mouth is white, and its anal fin has 12 rays or fewer.



WALLEYE AND NORTHERN PIKE: Both these popular game fish inhabit the estuary of the St. Louis River and migrate into Lake Superior after they spawn in the spring. Better treatment of industrial and municipal sewage in the St. Louis valley increased the number of fish and made them more palatable.



WHITEFISH AND HERRING: The lake whitefish, lake herring (also called cisco) and several related species are important forage fish. Though not prized as game fish, they long were the staple of the commercial fishery. Whitefish, the largest of the group, may exceed four pounds.



Fishing Ethics

Large migrations of large fish to North Shore streams attract large crowds of anglers. It also attracts people who exhibit bad manners and poor judgment. Their littering, intentional snagging of fish and other unsporting behavior offend anglers and landowners alike. Remember the following regulations when you fish Lake Superior streams:

- A 10-inch minimum size limit on trout is intended to protect steelhead and salmon fingerlings.
- The use of no more than a single hook in streams is meant to prevent snagging. Treble hooks are not allowed, even on lures that are equipped with them.
- Each angler may fish only one line on a stream or within 100 yards of a river mouth.
- Finally, don't leave fish remains and other offal piled on the side of the stream, where the stench offends everyone on the river.

Walleye

Increased angling pressures challenge walleye management

Minnesota has more walleye, walleye lakes and walleye anglers than any other state. The annual fishing "opener" leaves no doubt that the walleye is the state's most popular game fish. On the afternoon before the season opens, the highways are packed with vehicles toting big-water boats bristling with the latest electronics and other weaponry of the modern walleye hunter. Anglers who may never go fishing the rest of the year are driving to Mille Lacs, Winnibigoshish, Leech, Saganaga, Kabetogama, Vermilion and other popular walleye lakes for the annual tradition.

That is not the end of it. Many anglers are more furtive in their pursuit of Minnesota's state fish. They may fish the less well-known but productive lakes of southern and western Minnesota. They may portage into remote northern waters or even put on tennis shoes and shorts and wade a small bouldery stream with an ultralight spinning rod to catch walleye.

What is the allure of this blank-eyed fish? Surely not its fight, which is only fair. For some anglers it is the delightful taste of walleye fillets. For others it is the sport of finding and outwitting this often elusive and finicky fish. Many others simply join in the long-standing tradition of walleye fishing with little thought given to why they do it.

Whatever the reasons, walleye fishing is big sport. **Each year in Minnesota, anglers keep about 3.5 million walleye totalling 4 million pounds.** The walleye is also big business. Throughout the resort towns of Minnesota are images of the walleye, from picture postcards to huge statues — icons of Minnesota's tourism industry. A recent study estimated that anglers spend more than $700 million a year in Minnesota. Much of that is spent in pursuit of walleye.

This intense interest in the walleye puts a premium on effective fish management. The DNR protects habitat, limits the catch through regulations, and stocks fish where natural reproduction is limited and other desirable fish species will not be harmed. Recently, on a few lakes, the DNR has instituted special regulations that are intended to increase the number of large fish that anglers can catch.

Habitat Protection

The best way to maintain walleye numbers is to protect the variety of lakes and streams they inhabit through existing laws limiting pollution and regulating reservoir and tailrace water levels. Shoreland zoning and related laws aid walleye and other fish by controlling lake and river shoreline development and protecting aquatic plants that walleye or forage fish use for cover. It is particularly important to protect rocky spawning shoals from pollution and sedimentation.

Sometimes, walleye spawning areas can be enlarged or rehabilitated by trucking loads of carefully selected boulders and cobble over the ice and dropping it at a precise location over the spawning area. Warm weather melts the ice and deposits the substrate. However, these artificial spawning reefs have their limits. Imagine the amount of rock that would have to be hauled onto Mille Lacs to add significantly to the thousands of acres of natural spawning habitat.

The water level of large reservoirs can be manipulated to increase walleye reproduction. Low water during much of the year allows waves to crash over rocky reefs and shallows, clearing sediment from these spawning areas. By raising the water level during early spring, as would happen under natural conditions, reservoir managers cover these reefs with water of adequate depth for the walleye to spawn.

Management

On most waters, closed seasons protect walleye during spawning. Possession limits distribute the total catch among many anglers. Lately, fish managers have been looking at special regulations as a way to protect walleye.

For many years fish managers operated under the principle of maximum sustained yield. Their goal was to provide to anglers year after year the greatest possible poundage of desirable fish — either as a few lunkers or as many small walleye.

Managed in this way, Minnesota's large lakes have yielded to anglers millions of walleye every year. In total weight of walleye, our lakes are as productive as ever. But anglers have complained that the fish are getting smaller.

Several things may be at the root of this. Modern walleye fishing techniques are perhaps better at catching medium-sized fish than large fish. Also, a strong year-class can dominate the walleye population; when these abundant fish are small, it will appear as though the lake is filled with nothing but small fish. Then, as these abundant fish grow larger, the angler will begin catching more large fish.

Nonetheless, evidence suggests that the average size of walleye in the creel from the large walleye lakes is indeed declining — not because of some temporary aberration, but over the long term. In Winnibigoshish, for example, fishing pressure increased more than 700 percent from 1939 to 1977 while walleye yields (in pounds per acre) increased 150 percent. Most dramatically, however, the average weight of walleye that were kept declined from 2.2 pounds in 1939 to 1.3 pounds in the 1950s to 1.1 pounds in the 1970s. If Winnibigoshish is any indication, the average angler is catching fewer and smaller walleye. The problem apparently stems from fishing pressure.

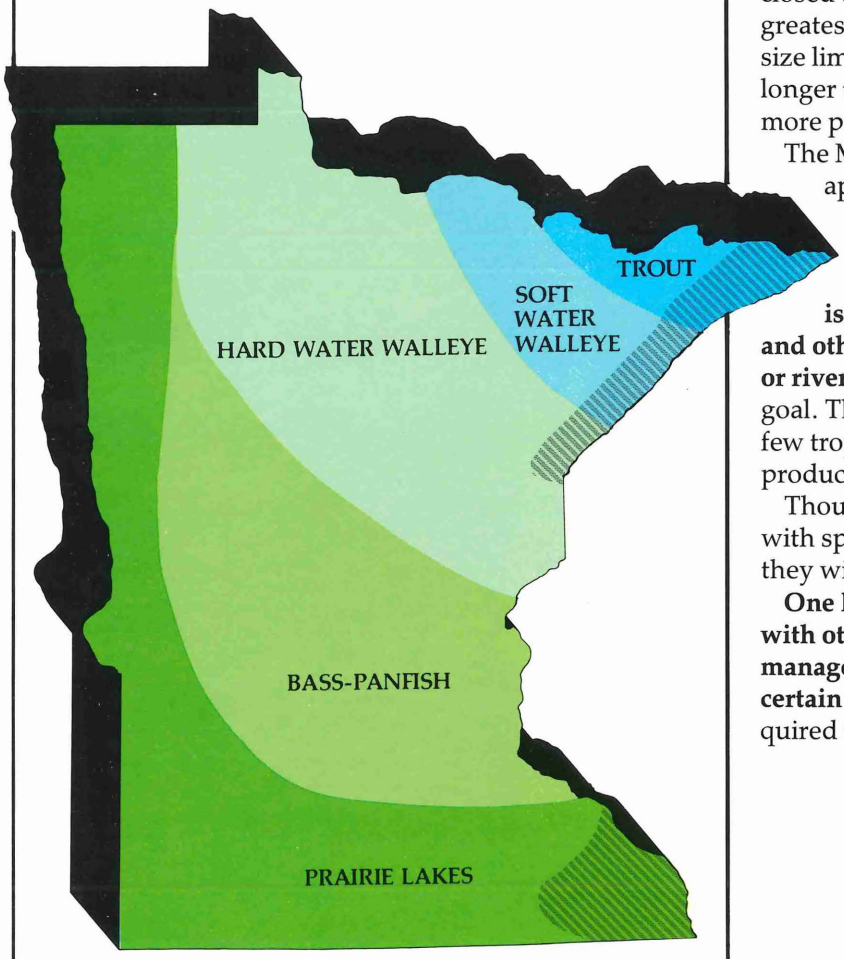
Not only are more anglers spending more time at their sport; they also are better educated in their fishing techniques and better outfitted. This intense fishing pressure is like a mower blade, chopping off the seed and blossom and leaving the stubble — in this case the small walleye that proliferate to fill the void left by the larger fish. As the average size of the fish drops, anglers are willing to keep smaller and smaller fish, and the problem of fishing pressure is compounded.

While our lakes produce as many pounds of fish as ever, anglers have noticed that each is catching fewer fish (because they're sharing the yield with other anglers) and that these fish are smaller. As each person's catch declines in number and size of fish, the old management philosophy of maximum sustained yield — large fish or small — comes increasingly under attack.

What's the solution?

Stocking large lakes is futile. Mille Lacs can produce more than 2 billion walleye fry a year--seven times the DNR's annual hatchery production. Besides, there are plenty of small fish. Anglers want more LARGE fish. And raising and releasing lunkers is prohibitively expensive.

Ecological Types of Minnesota Waters



If we can't add large fish, we have one option: we can TAKE fewer large fish.

Ways of limiting the take include shortening the season and outlawing depthfinders and other sophisticated equipment. These measures would be unpopular. **The DNR would prefer to limit directly the number of fish kept rather than to cut down on the amount of time anglers spend on the water or to dictate the equipment they can use.**

Many fishing groups have suggested that anglers practice more "catch-and-release" fishing and that the DNR institute size limits to protect large fish.

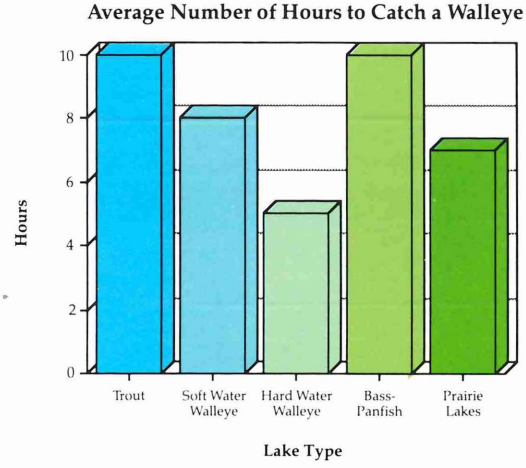
When complaints erupted about poor fishing on Mille Lacs, the DNR and a local anglers group developed just such a plan. Early-season night fishing was closed to limit the take when fishing pressure was greatest and walleye were most vulnerable. A new size limit allowed anglers a daily bag of only one fish longer than 20 inches to protect large fish and put more pressure on small fish.

The Mille Lacs regulations are unusual in that they apply only to Mille Lacs. They do not affect the statewide seasons and limits. Thus, they are called "special regulations."

Special regulations are tailored to characteristics of the fish population, fishing pressure and other problems unique to a single lake or river. They may also be designed for a particular goal. Thus, one lake may be managed to produce a few trophy fish while another may be managed to produce many smaller fish for the frying pan.

Though the DNR is just beginning to experiment with special regulations for walleye, it appears likely they will become increasingly important.

One kind of special regulation that has been used with other species and may be useful in walleye management is the "slot" limit, which protects a certain size of fish. For example, anglers may be required to return all fish between 18 and 22 inches but



This is an average of all anglers and does not accurately indicate what an expert angler might catch while fishing for this species.

can keep fish outside that slot. The slot limit would allow anglers to keep "eating-sized" fish as well as a few trophies. Medium-sized fish would be protected to make for better fishing (not to protect brood stock, which usually exists in sufficient numbers). The number of small fish would be reduced through angling pressure and also through cannibalism by large walleye. Often, growth rates improve as the small fish become fewer, and the number of large fish increases in this way as well. The secret lies in finding the proper slot for the productivity of the lake and the growth rates of the walleye in it. Success depends on good survey data.

What about the familiar minimum-size limit? For example, a regulation may require that all fish under 12 inches be returned to the water. That way, the little ones will have a chance to grow to be big ones, right? Well, no. They'll have the chance to grow to about 11-3/4 inches and then likely will be yanked from the lake. A minimum-size limit will produce big walleye only if it is pushed up to lunker size--22 inches, for example. That kind of restriction is nearly a catch-and-release requirement.

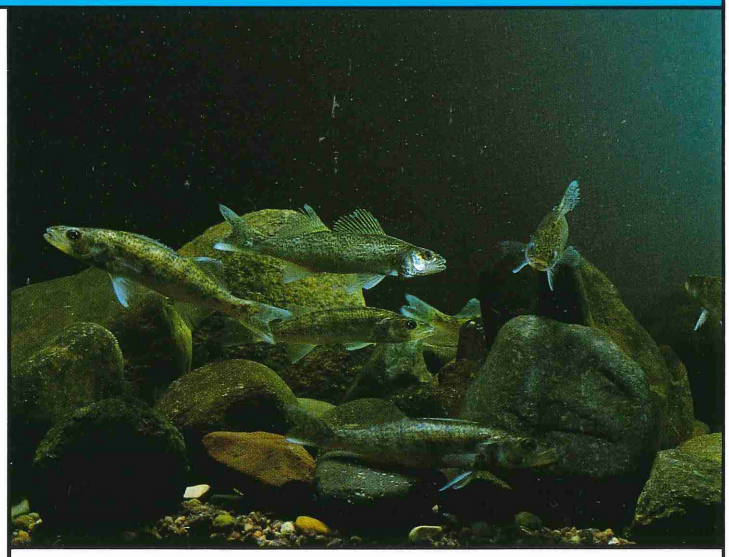
Though size restrictions have been a hot topic, there are other ways to limit the kill and improve fishing.

One way is to greatly reduce the possession limit — perhaps from 6 to 1 — and thus encourage catch-and-release fishing.

Stocking

Minnesota's cool-water hatcheries and rearing ponds each year produce 2 million to 5 million walleye fingerlings and millions of fry. The major value is to provide walleye fishing in areas of the state void of natural walleye populations. Over the years, the mixture of ever-increasing walleye mania and the lure of tourism bucks has produced an over-reliance on stocking. As a result of this emphasis on hatchery production, many anglers wrongly believed that stocking was a panacea for poor fishing, that any lake could be a walleye lake, and that the walleye could not thrive without artificial propagation.

None of that is true. Simply put, **stocking a lot of small fish does not guarantee catching a lot of big fish.** Furthermore, native Minnesota walleye have



flourished since the Ice Age without our help. But having relied on the stocking program for several decades, the DNR has found it difficult to convince anglers of other effective management tools.

Still, the effect on the state's total fishery is limited. One fish manager estimated that perhaps only 5 percent of the walleye that anglers catch come from a hatchery. The rest were the result of natural reproduction. "We survive on Mother Nature's bounty," he said, "which is a heck of a lot cheaper than stocking fish."

In the words of one DNR report: "There is no evidence that the walleye population of the stocked natural walleye lakes sampled were increased over that which might occur naturally without stocking." The point is this: Given the great cost of raising walleye, why put them in lakes where walleye already spawn successfully or where stocked walleye do not improve fishing?

There is evidence that stocking can be harmful as well. Stocked walleye may compete for food with other game fish, particularly largemouth or smallmouth bass. The result may be fewer or smaller bass. And because the bass is a more efficient predator of small sunfish than the walleye (which feeds more on perch), the introduction of walleye may contribute to stunting of the panfish. These are all issues that are just now being studied. It seems, however, that stocking is not the benign activity it once was assumed to be.

Despite its limitations, stocking is a useful tool for some purposes:

— Walleye are introduced to lakes that have been "rehabilitated" (that is, where the previous fish were deemed undesirable and removed). Where habitat is suitable, these introductions often establish self-sustaining fisheries.

— In one of the most popular and effective uses of stocking, **walleye fry are put in heavily used lakes that occasionally winter-kill.** These lakes — many of them in southern Minnesota — are fertile, and walleye fry quickly grow into "keepers." The fish may be given some protection with aerators to increase winter oxygen, but still, stocking these lakes is a gamble. The risk is losing great numbers of game fish before they can be caught. The payoff is a desirable game fish where otherwise nongame fish would swim. Heavy use by anglers makes the gamble worth taking.

— Walleye are also stocked in lakes with all the elements necessary for survival except suitable spawning areas. This approach works in lakes that once were natural walleye producers but that since have succumbed to farm runoff and lakeshore development. As fertilizers, septic-tank seepages and other sources of nutrients have enriched waters, algae proliferate and smother walleye eggs. In this instance, stocking is a prosthesis for an injured body of water.

— Occasionally, walleye are stocked to bolster the number of catchable fish where heavy use or poor reproduction justifies the expense. This is extremely expensive, however. Only occasionally is it a good investment.

The Future

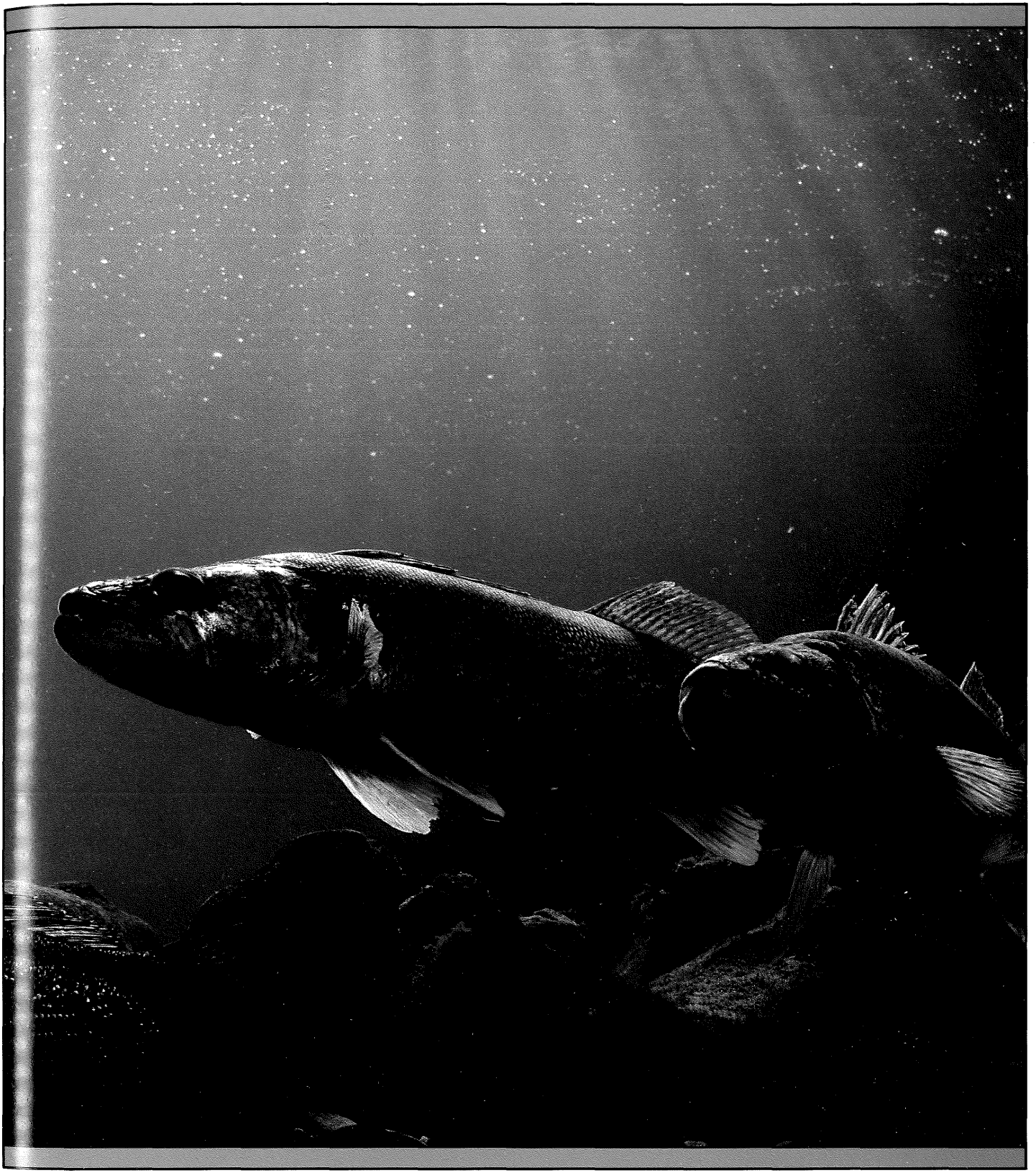
Loss of habitat and increasing fishing pressure will continue to be the biggest issues in walleye management.

If walleye are to have good areas to spawn and grow, regulations must prevent water pollution, control agricultural runoff, restrict lakeshore development, and control the clearing of aquatic vegetation. If habitat can be protected, anglers and fish managers still must contend with fishing pressure. As more people fish more effectively on the state's big walleye lakes, they will have two choices:

— Put up with reduced quality of walleye fishing, or

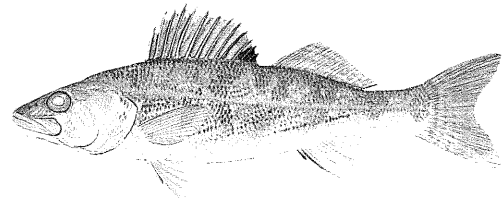
— Reduce the kill of desirable fish through catch-and-release fishing, size limits, preference for other species, or other methods that limit the walleye catch. Some lakes may be managed for trophies; others for many pan-sized fish. Anglers may find first-rate walleye fishing on lesser-known streams and small lakes.

Walleye stocking, that popularly imagined panacea, is a useful tool in correcting problems and maintaining fisheries in special circumstances on a modest scale. But as medicine for walleye fishing statewide, it isn't the answer.



Minnesota's Perch Family

Walleye: The walleye averages 1 to 2 pounds in most waters, though it occasionally exceeds 10. The torpedo-shaped fish ranges from dark olive brown to yellowish gold, its sides often marked with brassy flecks. The walleye is named for its pearlescent eye, which is caused by the *tapetum lucidum,* a reflective layer of pigment that helps the fish to see and feed at night or in turbid water. Unlike the sauger, the walleye lacks spots on its dusky dorsal fin, except for a dark splotch at the rear base of the fin, a marking the sauger does not have. The lower tip of the walleye's tail is white, unlike the all-dark lower lobe of the sauger.



The walleye is native to most of Minnesota, flourishing in large, shallow, windswept lakes with gravel shoals, such as Mille Lacs, Leech, Winnibigoshish, Upper and Lower Red Lake, Lake of the Woods and Lake Vermilion. It is also native to many smaller lakes and streams in all of Minnesota's major drainages. Because of its popularity as a game and food fish, the walleye was introduced to many other lakes, where it has become established. The walleye now occupies about 1,700 lakes totalling 2 million acres and 100 warm-water streams totalling 3,000 miles.

The walleye's low-light vision and sensitivity to bright light play a large role in its behavior. They usually feed in shallow water at dawn and dusk. Walleye are fish-eaters, preying heavily on yellow perch, which cannot see as well as the walleye in low light and thus are easy prey at night. With daylight, walleye move into the shadows of cliffs, boulders, logs and even heavy weeds. Lacking this cover, they seek shelter in deeper water. Walleye remain more active throughout the day if turbidity, wave chop or clouds reduce rightness. Walleye may suspend over deep water to feed on open-water species.

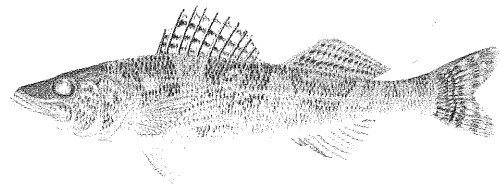
Walleye spawn over rock, rubble, gravel and similar substrate in rivers or windswept shallows in water 1 to 6 feet deep, where current clears away fine sediment and will cleanse and aerate eggs. Male walleye move into spawning areas in early spring when the water temperature may be only a few degrees above freezing. The larger females arrive later. Spawning reaches its peak when water temperature ranges from 42 to 50 degrees. A five-pound female deposits more than 100,000 eggs. Neither parent cares for the eggs in any way.

Depending on weather, the success of spawning can vary greatly year to year. Rapidly warming water can cause eggs to hatch prematurely. Prolonged cool weather can delay and impair hatching. A cold

snap after the hatch can suppress the production of microcrustaceans that walleye fry eat. Year-class strength can vary 100-fold, depending on the success of the hatch and survival of the fry. One walleye year-class may dominate in a lake, while walleye a year older or a year younger are scarce.

After spawning, walleye move to feeding areas. Walleye are a "cool-water" species, preferring warmer water than do trout and cooler water than do bass and panfish. As the preferred forage fish become larger and more abundant during the summer and walleye need to spend less time hunting food, walleye commonly spend more time in deep, cool water, away from bright light, where they are most comfortable.

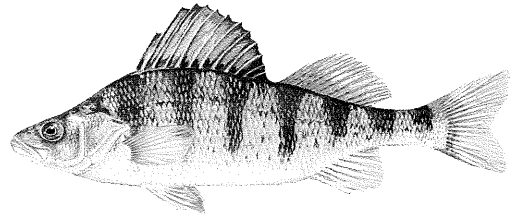
Sauger: Sauger are similar to walleye in appearance and habits, though their distribution is more limited. They live in Lake St. Croix, the Minnesota River and the Mississippi River below the Twin Cities. They also are common in Lake of the Woods, Rainy Lake and Lake Kabetogama. The sauger is smaller and more slender than the walleye, seldom exceeding 3 pounds. Its dorsal fin, unlike the walleye's, is marked by rows of dark spots and lacks the dark blotch at the rear base. The sauger also lacks the white lower tail tip. The sauger sees even better than the walleye in darkness or turbid water, and this determines their distribution.



Though also excellent table fare, the sauger is less popular than the walleye because of its smaller size. The DNR undertakes no direct sauger management other than the evaluation and protection of habitat and the forage base.

Yellow Perch: Yellow perch are golden or brassy yellow with six to nine dark vertical bars on their sides. They do not have the canine teeth of walleye and sauger.

Perch are found throughout the state, often in such numbers they are stunted for lack of food. Occasionally infected with unappetizing parasites, they are considered pests except in large hard-water walleye lakes, where they may exceed a pound and are excellent table fare. Perch feed on a variety of small fish and invertebrates.



Yellow perch may be the single most important prey species in many lakes for largemouth bass, northern pike and particularly walleye. Like the walleye, perch of one year-class may be superabundant while another year-class may be nearly absent. Strong perch year-classes generally coincide with abundant walleye year-classes. Wild fluctuations in perch numbers influence the health and growth rates of walleye. They also affect angling. Fishing may be poor when forage-size perch are abundant, simply because walleye are well fed.

Live Bait and Catch-and-Release

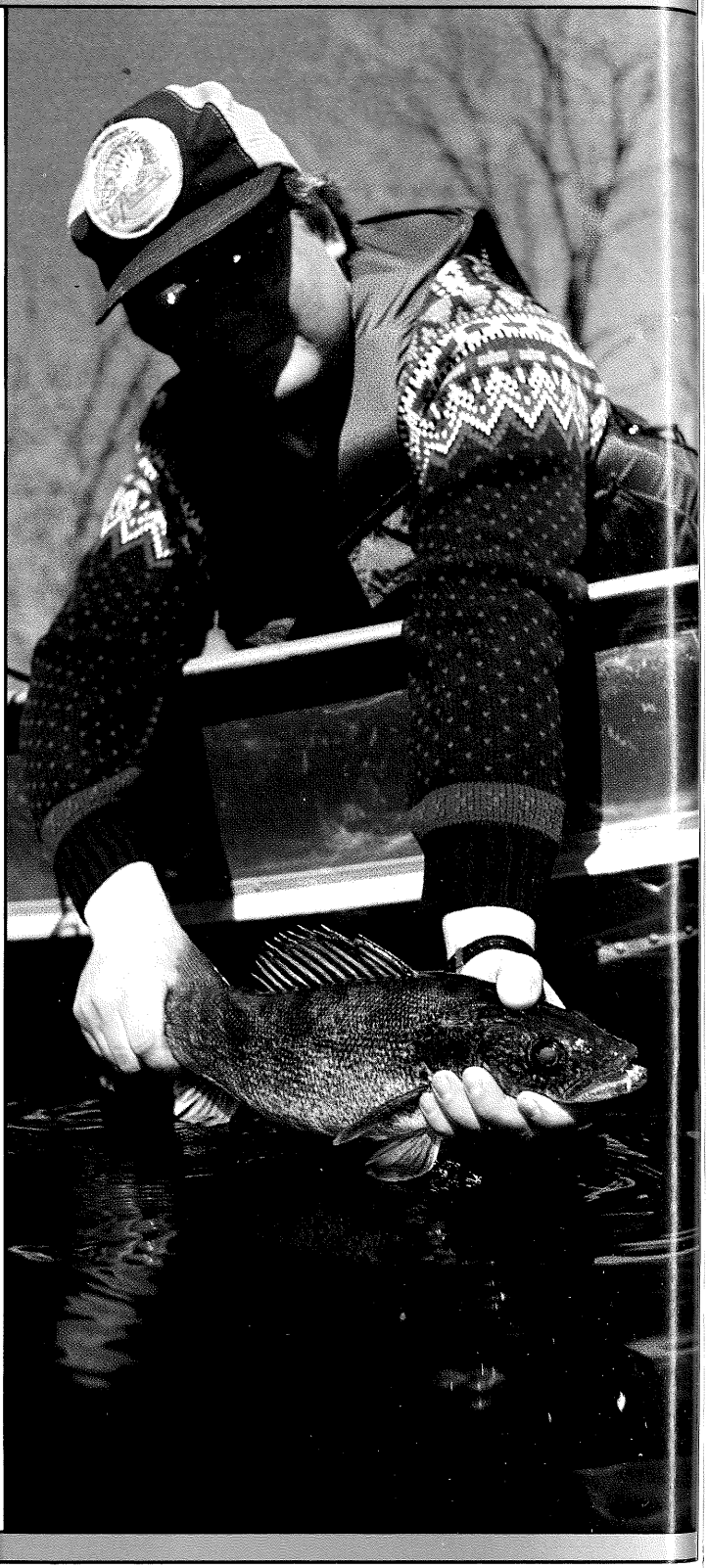
Live-bait rigs hook fish more deeply than artificial lures and thus kill more fish — whether badly hooked fish are put on a stringer or thrown back into the lake. So, the conventional wisdom holds that live bait must be banned if regulations require anglers to release many of their fish.

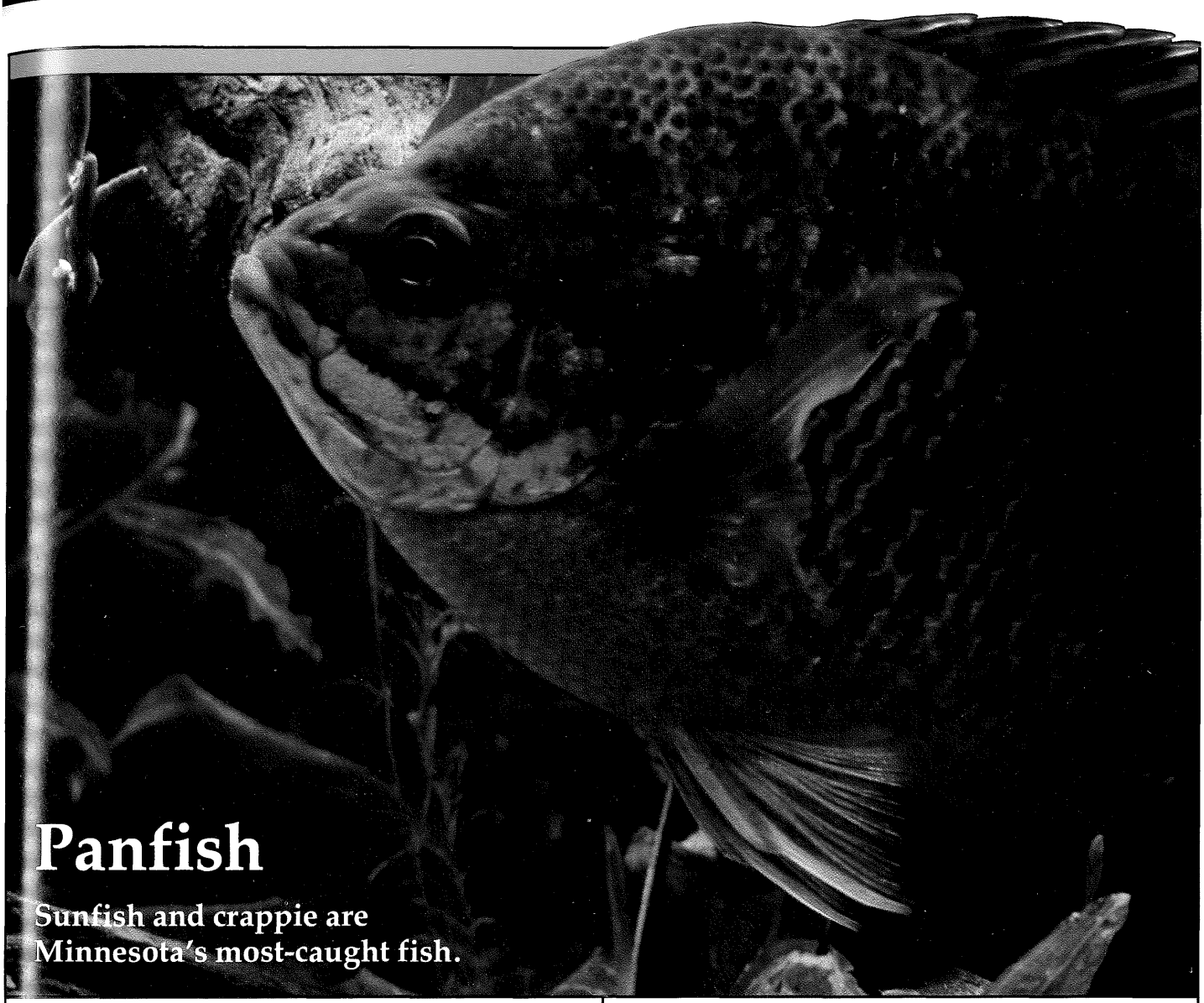
A recent DNR study confirms that live bait kills more walleye. But it also suggests that hooking mortality with leeches is low enough to make catch- and-release angling worthwhile.

The 1985-86 study compared the hooking mortality caused by crankbaits and leeches, two popular walleye rigs. None of the walleye caught on crankbaits later died. The hooking mortality for leeches was about 10 percent — significant, but still low enough that anglers could release fish with fair confidence that they would survive. (Interestingly, the study also showed that crankbaits caught larger fish.)

Also important to the survival of fish is how they are landed and handled. If you intend to release a fish, don't play it to exhaustion, do not hold it by the eyes, cut the line if the fish is deeply hooked, and return the fish to the water immediately. In fact, it is often possible to unhook a fish without ever lifting it from the water.

By keeping less than their limit and releasing some fish — especially large fish — anglers perpetuate the quality of their own fishing and that of other anglers. Catch-and-release fishing — whether voluntary or required by special regulations — will probably play an ever-larger role in fish management.





Panfish

Sunfish and crappie are Minnesota's most-caught fish.

Despite Minnesota's obsession with the walleye, the rising popularity of the largemouth bass and the wish of many anglers to catch a trophy pike or chinook salmon — the fish that people catch most, is the panfish. Bluegill, pumpkinseed, black crappie and white crappie and other pan-sized members of the sunfish clan account for most of the fish caught in the state. In the anglers' creel, panfish outnumber walleye 20 to 1 and weigh five times more.

These little fish also offer fine sport. Bluegill and other sunfish are excellent quarry for beginning or expert fly-rodders. Crappies are sporting on ultralight tackle. Fishing for rock bass can teach beginners the basics of stream angling. White bass feeding frenzies can provide some of the fastest action of any kind of fishing.

Anglers frequently complain of the small size of sunfish and crappie in heavily fished lakes. So it's not surprising that one fish biologist remarked, ''If we could put two-to-the-pound sunfish in the angler's bag, we could be the most popular management agency in the state.'' That, in a nutshell, is the goal of much of Minnesota's panfish management.

Management

Bluegill are one of the largest, most popular and most widespread sunfish not only in Minnesota, but also in the nation. So, the bluegill has been studied more thoroughly and managed more intensively than other panfish. Consequently, the work discussed here has been aimed primarily at these popular fish, though many of the principles apply to other sunfish as well.

Too Many Fish

Because bluegill are terribly prolific, stocking is used only to introduce fish to a body of water or in highly used public fishing ponds. More often the problem is too many tiny bluegill and an absence of large sunfish, a condition particularly common in heavily fished lakes. The cause of this ''stunting,'' as it's often called, is not truly known. It might be true stunting — slow growth because of intense competition for food and an abundance of young fish. Or it may simply be a result of overfishing; that is, anglers simply remove most of the ''keepers,'' leaving behind many small fish that further proliferate in the absence of larger sunfish.

Stunting

The problem isn't discovering why bluegills are often stunted but what is the best mechanism to control their numbers so stunting also can be managed. For years fish managers believed that if a lake is filled with small panfish, the cause was intense competition for food. Without adequate prey, sunfish continue to reproduce but simply grow slower.

Stunting might be caused by an abundance of excellent spawning habitat in conjunction with poor growing conditions, such as a lack of forage. Moreover, thick weed growth — escape cover — allows sunfish to escape predators and thus survive in greater numbers.

Another cause might be a lack of large game fish. Without a suitable predator to thin the ranks of small sunfish, the population remains too high for any individual fish to grow very fast.

These may be the causes of stunting. But how do fish managers correct it?

One approach is to remove small bluegill, but this sounds easier than it is. During the 1940s and '50s, fish managers tried seining bluegill to reduce their numbers but couldn't remove enough fish to make a difference. In a later experiment, managers used a herbicide to destroy weeds — ''escape cover'' — to make the bluegill more vulnerable to predators. This, too, was judged a failure.

In a more successful attempt to reduce the number of bluegill and increase their size, the DNR treated a lake with a toxicant in such a way to kill most small bluegill while sparing the larger fish. The experiment worked, but chemical treatment was expensive, and

one of the chemicals used in these treatments is no longer made.

Another approach is to try to increase predation on small sunfish. Anglers and fish managers long thought that an abundance of big northern pike would keep bluegill in check. Such is not the case, however. Pike eat tremendous numbers of fish, but mostly suckers, minnows and perch. Whether because of the bluegill's spiny-rayed dish shape or its ability to take cover in thick weeds, pike do not eat enough bluegill to reduce their numbers.

Largemouth bass appear to be a different story. They feed heavily on bluegill and seem adept at ambushing sunfish in heavy weeds. Largemouth will feed on bluegill up to one-quarter their own length. Consequently, **a promising way of controlling bluegill numbers is by maintaining great numbers of medium-sized bass.** Bass appear to have two effects on bluegill. First, bass simply eat a lot of sunfish helps control their numbers. Second, bass force small, vulnerable sunfish into thick weeds; but the big sunfish — too large to be eaten by the bass — are free to forage wherever food is most plentiful. So the presence of bass reduces the competition between small sunfish and large, thus allowing the large sunfish to grow even larger and faster.

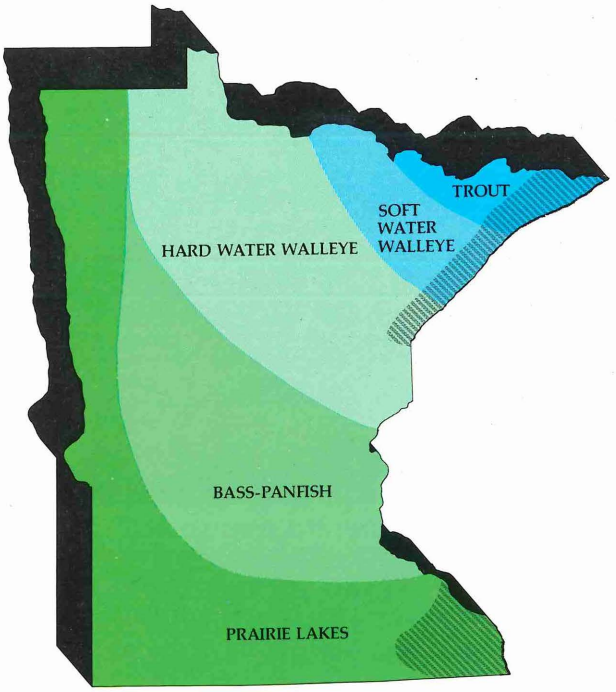
Researchers and managers have found that a minimum-size limit of about 16 inches on bass will direct fishing pressure toward the larger bass, leaving the more numerous 12- to 16-inch bass in the lake to prey on small bluegill. A great number of small and medium-sized bass seems more effective in controlling bluegill than does a lesser number of large bass.

So, a possible way to produce large bluegill is to engineer an abundant population of small to medium-sized bass. Conversely, fishing regulations that produce large bass (such as catch-and-release requirements), are successful at producing large bass, but are not nearly as effective in controlling bluegill numbers.

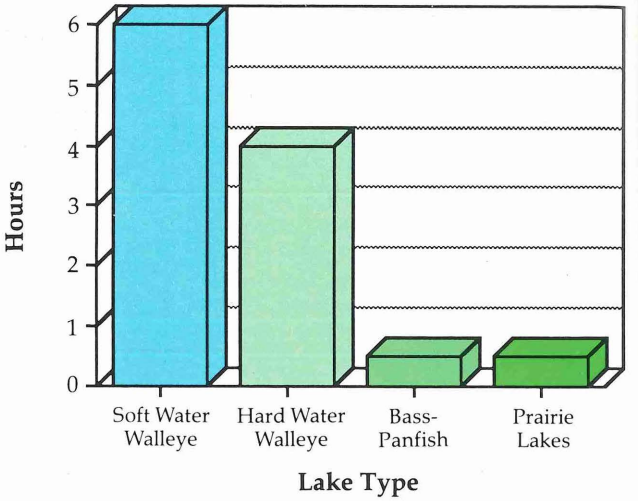
Thus, anglers and managers may have to choose either big bluegill or big bass in a lake. This is yet another argument for diversity in fish management. Some lakes can be devoted to stunted bluegill and large bass; others can be managed for big bluegill and many small bass.

Yellow perch also appear to influence bluegill numbers and size. Whether through predation, competition for food or some other means, an abundance of yellow perch is often related to fewer but larger bluegill. Fisheries scientists are continuing to study this relationship.

Ecological Types of Minnesota Waters



Average Number of Hours to Catch a Panfish

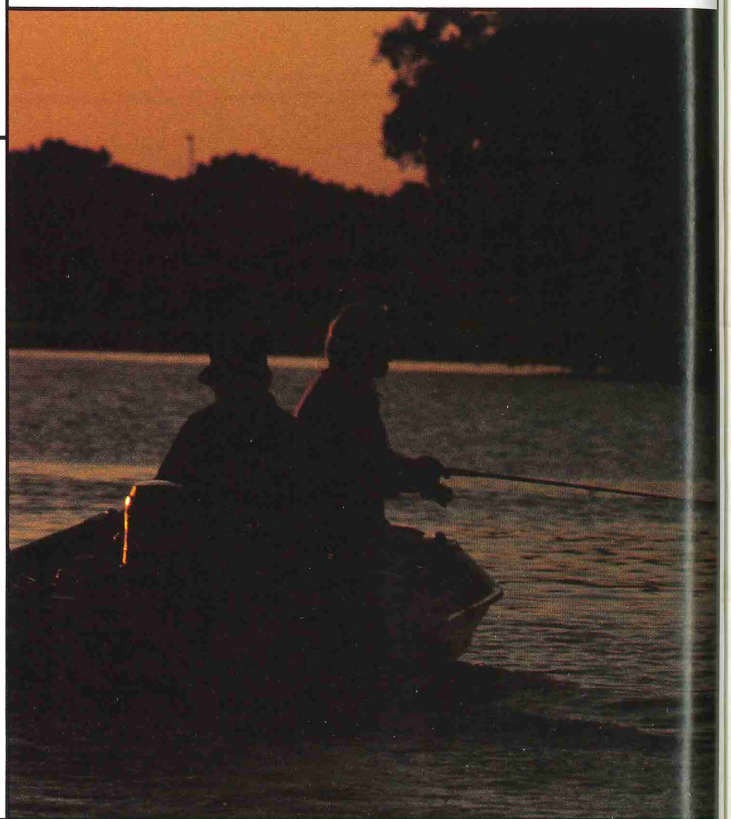


This is an average of all anglers and does not accurately indicate what an expert angler might catch while fishing for this species.

Overfishing

Many fish managers are beginning to believe that overfishing — not stunting — is the reason some lakes do not produce the big bluegill they once did. In such cases, growth rates are normal and food is plentiful, but anglers simply catch and remove all the good-sized fish, leaving behind the smaller bluegill, which multiply without the controlling influence of the large fish.

If this is true, the solution seems to be more straightforward: more big sunfish must be left in the lake if people are going to continue to enjoy catching them. Again, a diverse approach seems most promising. A few ''trophy bluegill'' lakes could be managed with a restricted harvest of big sunfish — perhaps even a catch-and-release requirement. Most lakes would continue to be managed with a liberal bag limit to provide panfish for the pan.



Habitat Protection

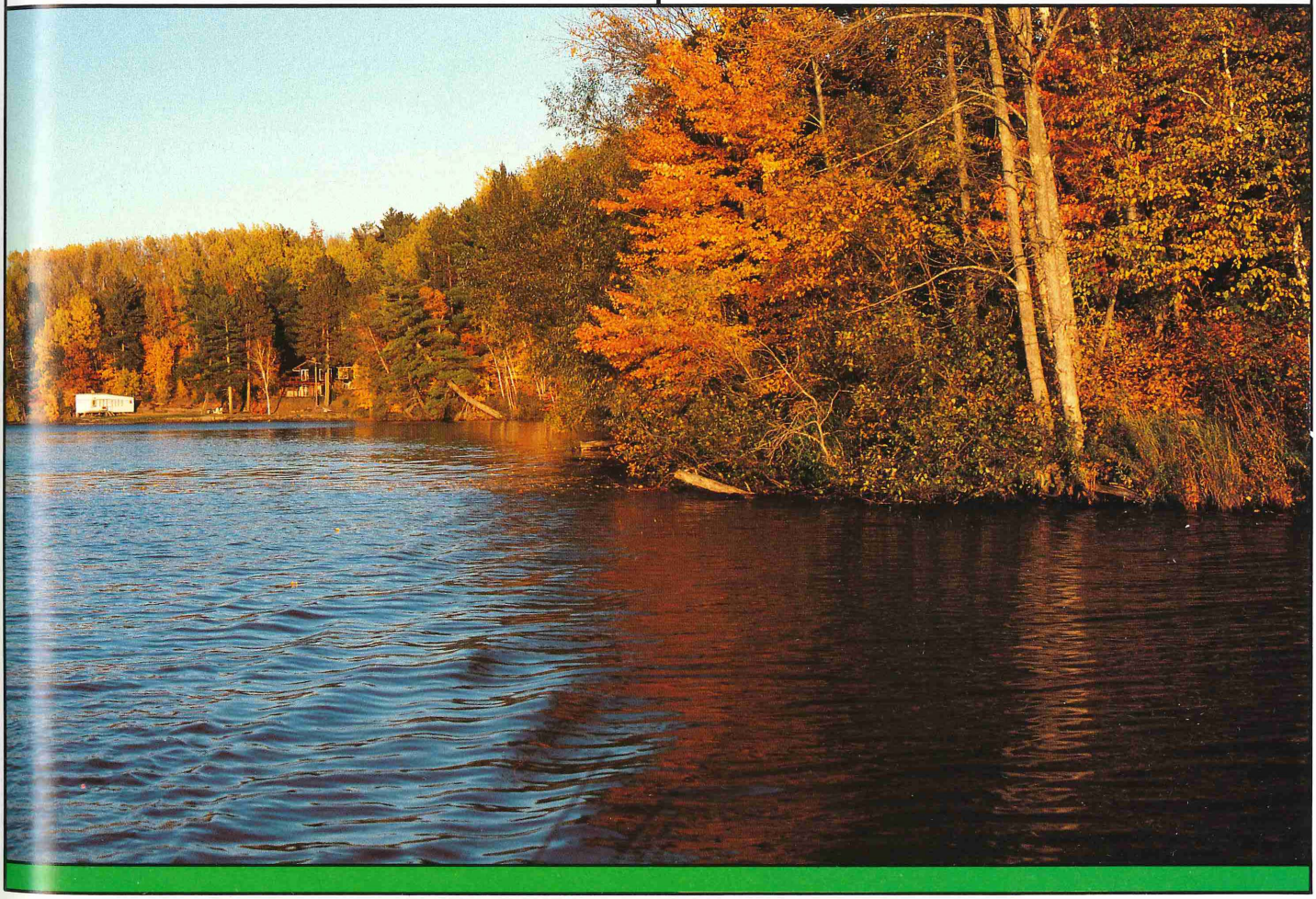
All talk of producing bigger sunfish makes sense only if they have the habitat necessary to spawn and grow. In general, sunfish need spawning areas with a firm bottom of sand, mud or gravel; beds of rooted aquatic weeds or other heavy cover to provide protection from predators; adequate dissolved oxygen; and reasonably clear water.

The state protects these kinds of habitat in a number of ways.

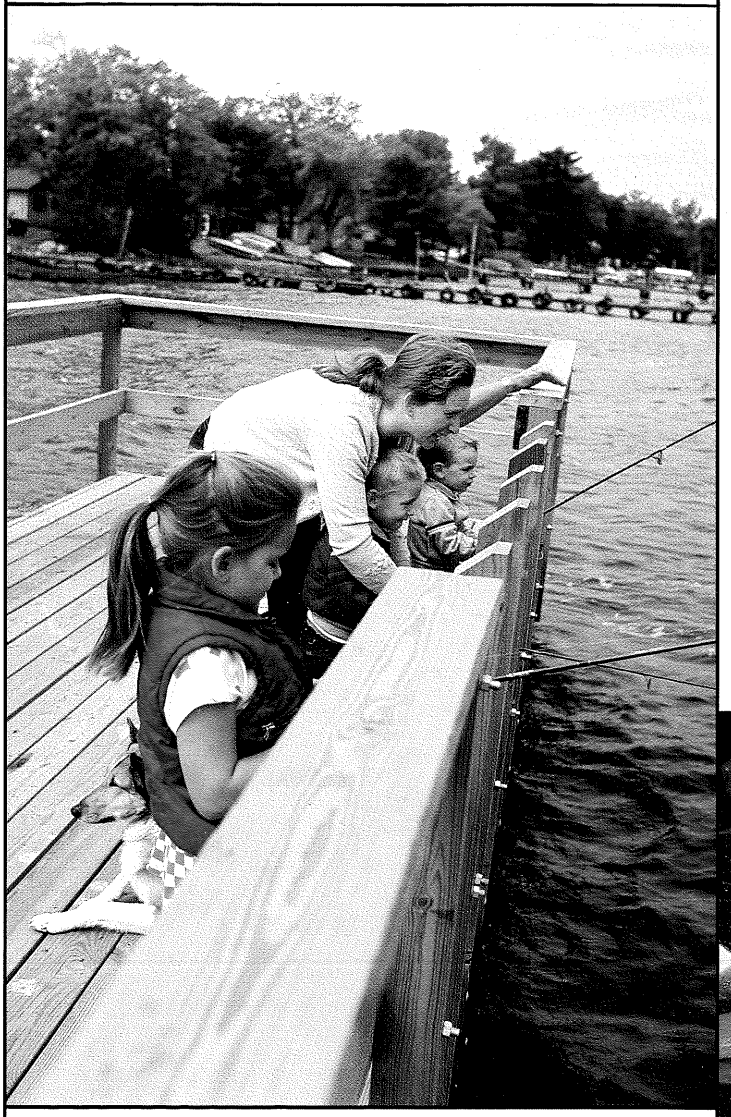
Shoreland zoning regulations restrict shoreline development that otherwise might pollute lakes with septic-system drainage. This effluent contributes to eutrophication, which decreases water clarity and dissolved oxygen. The DNR requires landowners to obtain a permit before removing aquatic weeds that provide cover for spawning, nursery areas and feeding.

Various state laws prohibit or limit various kinds of industrial or sewage-plant pollution that deprive fish of oxygen or poison them outright. Other forms of pollution — such as soil erosion, pesticide runoff from farmland, manure runoff from feedlots, and storm runoff from city streets and lawns — also consume oxygen and contribute to algae blooms and other signs of eutrophication. These "nonpoint sources" of pollution are extremely tough to correct.

Winter aeration systems are a boon to shallow, eutrophic lakes in southern Minnesota. In the past, these lakes would lose their fish to periodic winterkill. With aeration, however, these lakes produce fast-growing panfish that survive from year to year.



Other Management

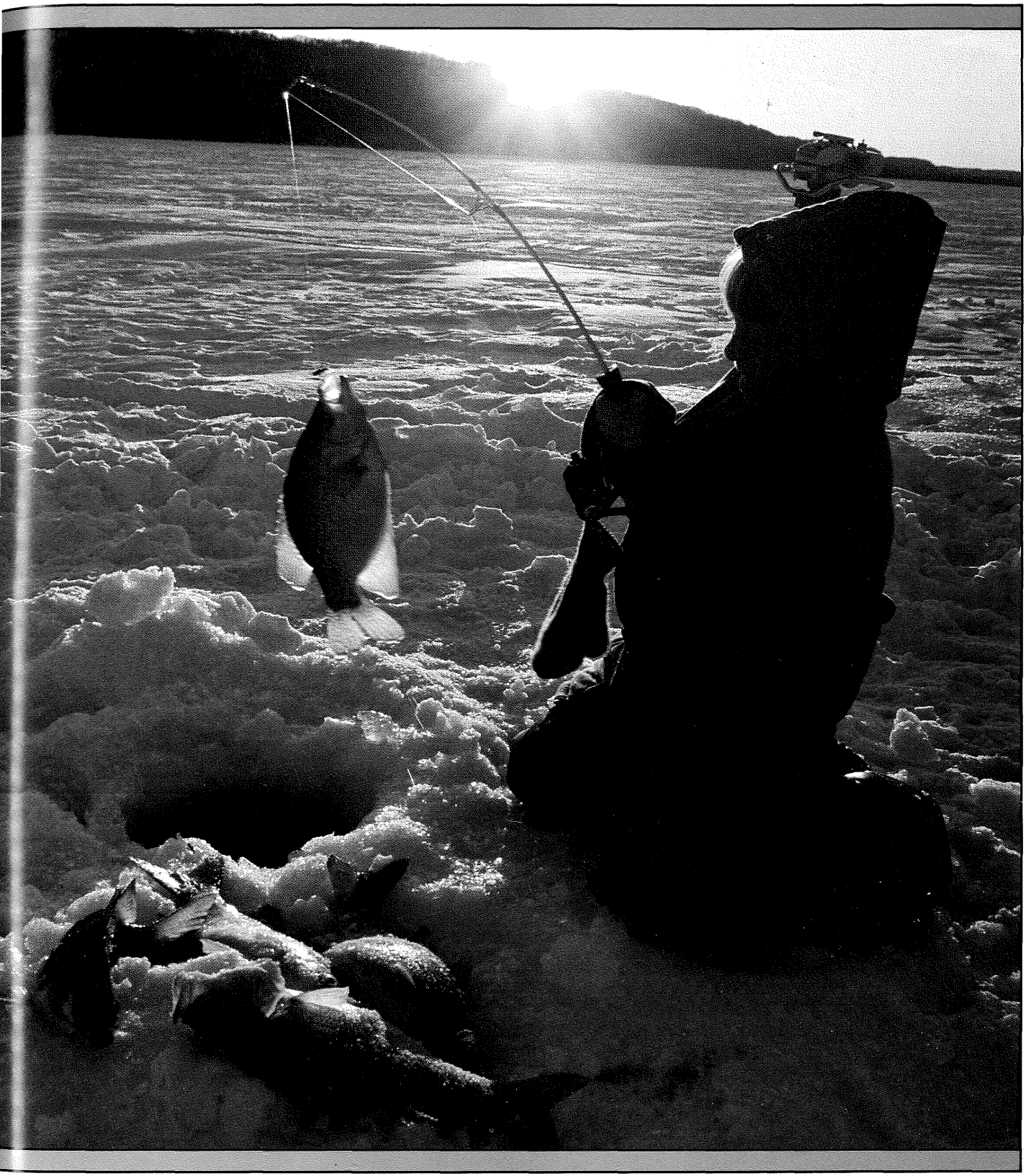


Greater opportunities to go fishing — usually to go fishing for panfish — result when the DNR installs a boat access, builds a fishing pier or clears brush on a bank to create a fishing site. The fishing piers are particularly popular with youngsters, the elderly, the handicapped and other anglers who may not have boats or access to more remote waters. The DNR sometimes anchors brush bundles near fishing piers to attract panfish.

In another program aimed at anglers with limited mobility, the DNR has worked with communities to stock crappie and bluegill in about two dozen "kid's fishing ponds" in the Twin Cities and a few elsewhere in the state. Catchable-sized fish are stocked in the spring to provide fishing for the summer. Some of these ponds are aerated, but most winterkill during severe winters.

Panfish also are important additions to many of the lakes that are chemically "rehabilitated" to rid them of carp and other rough fish. Once fish managers remove the undesirable denizens, they stock bluegill, crappie, and various large game fish. Fish managers try to establish a predator such as largemouth bass that will prevent panfish from becoming too abundant immediately after reclamation.

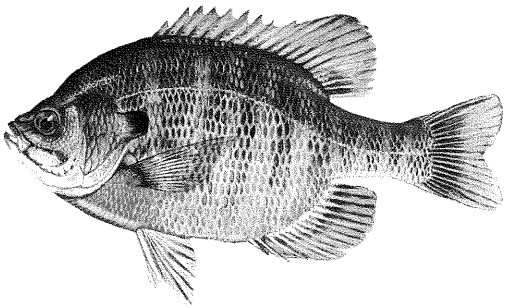
Much yet must be learned about managing for sunfish and other panfish. Manipulating predators and forage species in an effort to produce better fishing is complicated and must be attempted largely by trial and error. Clearly, however, these popular panfish must be managed as part of a larger fish community, rather than as individual species.



Minnesota's Panfish

Bluegill: The bluegill is Minnesota's largest and most popular sunfish. It is found in about 65 percent of the state's lakes and many of its slow streams, including the backwaters of the Mississippi. It is rare in the Lake Superior drainage.

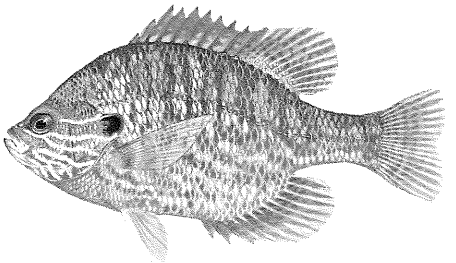
Appearance varies considerably among individuals, as is true with most sunfish. Most bluegill are light to dark olive, though older fish may have a purplish tinge. Cheeks and gill covers are often bluish and the ear flap is black. The rearward edge of the soft portion of the dorsal fin carries a dark blotch. Breeding males are marked by bright blue and orange. Females and younger fish are less colorful and are often marked by dark vertical bars on their olive backs. Though they occasionally exceed a pound, an 8-inch bluegill is considered large.



The bluegill spawns from late May or through much of the summer in water temperatures of 67 to 80 degrees. The male fans out a nest in firm-bottomed shallows, often within a colony of dozens of other nests. A single female can deposit more than 50,000 eggs. The male then guards eggs and fry.

The bluegill's mouth is small; it feeds mostly on aquatic insects and other small invertebrates. Young bluegill will feed in heavy weeds to avoid predators. Bluegill large enough to be of no interest to bass often swim freely in more open water, feeding heavily on tiny drifting zooplankton. This open-water feeding is especially common if bluegill must compete with pumpkinseed and green sunfish, which stay in the weeds. When food is scarce, bluegill will eat their own eggs.

Pumpkinseed: Like the bluegill, the pumpkinseed lives in many of Minnesota's lakes and streams. This popular sunfish is nearly as large as the bluegill. The pumpkinseed can be distinguished from the bluegill by the bright orange spot at the tip of the ear flap and the lack of a dark blotch on the soft portion of the dorsal. Breeding males are particularly colorful; their cheeks and gill covers are marked by wavy bright blue bars. Identifying and distinguishing sunfish is complicated by frequent hybridization.



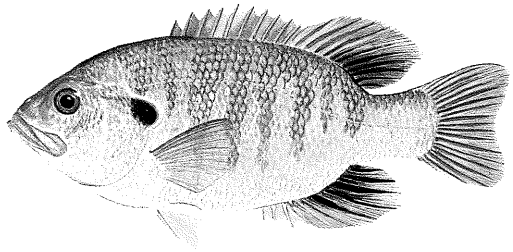
The pumpkinseed spawns from May until well into the summer, nesting in colonies and defending its nests, much as bluegill do. In fact, pumpkinseed sometimes build nests in bluegill colonies.

The pumpkinseed eats aquatic insects and other invertebrates. It uses its specially adapted teeth to feed heavily on snails.

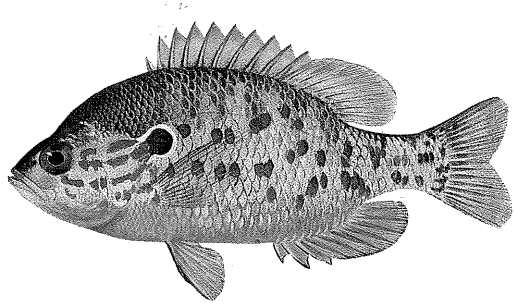
Green sunfish: Drab in comparison to others of this tribe, the green sunfish is also distinguished by a mouth far larger than is typical of other sunfish. The ear lobe is black with a pale margin. The green sunfish is common in many lakes throughout the state and thrives in creeks. It tolerates greater turbidity and lower dissolved oxygen than bluegill or pumpkinseed.

The green sunfish usually is far smaller than pumpkinseed or bluegill, though hybridization with the larger species produces larger fish. Spawning times and habits are similar to those of other sunfish.

Like the bluegill, the green sunfish eats aquatic insects and other invertebrates and small fish. Because of its larger mouth, the green sunfish may eat larger critters than a bluegill of equal size, thus reducing competition between the species.



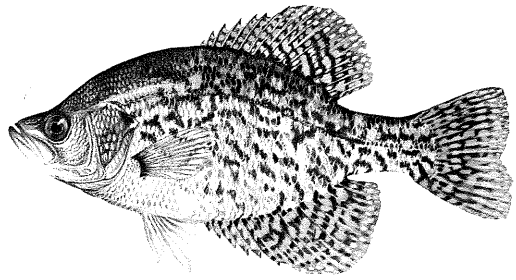
Orangespotted sunfish: The orangespotted is the smallest Minnesota sunfish, rarely reaching 4 inches. It is one of our most colorful species. Spawning males carry orange-red lines on the cheeks and gill covers. Their bellies and lower fins are reddish. Ear lobes are dark with a pale border. Spawning habits are similar to those of other sunfish. Found in southern Minnesota, the orangespotted sunfish is too small to be popular with anglers. It is more tolerant of pollution and turbidity than other sunfish. Declines in water quality enable the orangespotted sunfish to extend its range while more desirable sunfish decline.



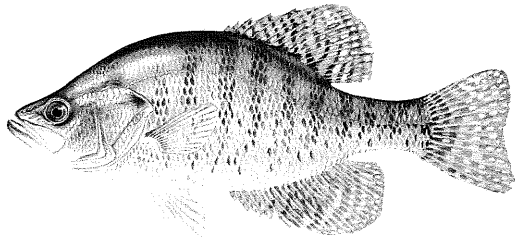
Black and white crappie: The black crappie and white crappie are among Minnesota's most popular fish. In the angler's creel, the black crappie probably ranks second behind the bluegill.

The black crappie is the more widely distributed of the two closely related species, occurring in most lakes throughout the state. The black crappie prefers deeper, cooler, clearer water than the white crappie does.

The two species are difficult to distinguish. The black crappie is generally darker overall and has seven or eight spines in its dorsal fin. The white crappie, on the other hand, often has markings arranged in vertical bars. It usually has five or six dorsal spines. The two species are similar in size; a 2-pound fish is unusually large.



Spawning habits for the two crappie species are similar. They spawn in May and June, in water temperatures in the mid-60s, in water up to 6 feet deep. Males build and guard nests in colonies. They mature early and are prolific; a large female may produce well over 100,000 eggs. Crappie are prone to stunting. Because a strong year-class often dominates in a lake, crappie often appear to be all of the same size. When these fish of a strong year-class grow large, the lake can gain a reputation as a crappie hot spot and then fade into mediocrity as a younger year class takes over.



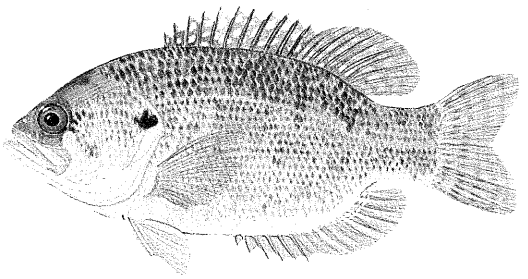
Young crappie eat small aquatic invertebrates. Adults can continue to feed on plankton but usually eat a lot of small fish as well. Crappie may compete with walleye to some degree because their habits are similar. Both species travel open water in schools, feeding on similar foods at night, dawn and dusk.

The most effective management is the protection of habitat and maintenance of good predator-prey balance in the lake.

Rock bass: Stout and heavy in comparison to the sunfishes and crappies, the rock bass has red eyes and brassy flanks with black spots. A large rock bass measures about 10 inches and weighs about a pound.

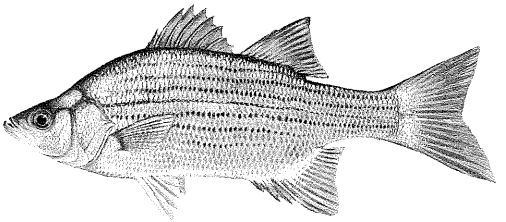
The rock bass spawns in the spring, when the water temperature ranges from the high 60s into the 70s. The male fans out a nest in coarse sand or gravel and guards the eggs and fry. It lives in many lakes and streams in Minnesota, generally preferring well-oxygenated, hard-water walleye lakes and walleye-centrarchid lakes and the creeks associated with them. The rock bass prefers boulder and sand bottoms. It eats small fish, insects, crayfish and other invertebrates.

Rock bass require little management other than the protection of its habitat from pollution and other environmental degradation.



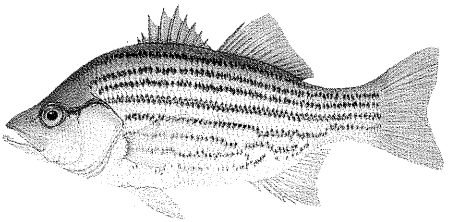
White bass and yellow bass: The panfish previously discussed in this brochure are centrarchids, or "spiny-rayed" fishes, and are closely related to largemouth and smallmouth bass. The white and yellow basses, despite their names, are not related to any of these. They are related to the much larger striped bass, a native of the Atlantic Ocean that has been stocked in freshwater but does not occur in Minnesota.

The white and yellow bass resemble one another, but as their names suggest, they are different colors. The white bass has separated dorsal fins, the second anal spine is one-third the length of the head, and the seven longitudinal stripes under the dorsal fins are solid. The yellow bass has joined dorsal fins, the second anal spine is half the length of the head, and the seven longitudinal stripes are broken. Both are deep bodied and occasionally exceed 2 pounds.

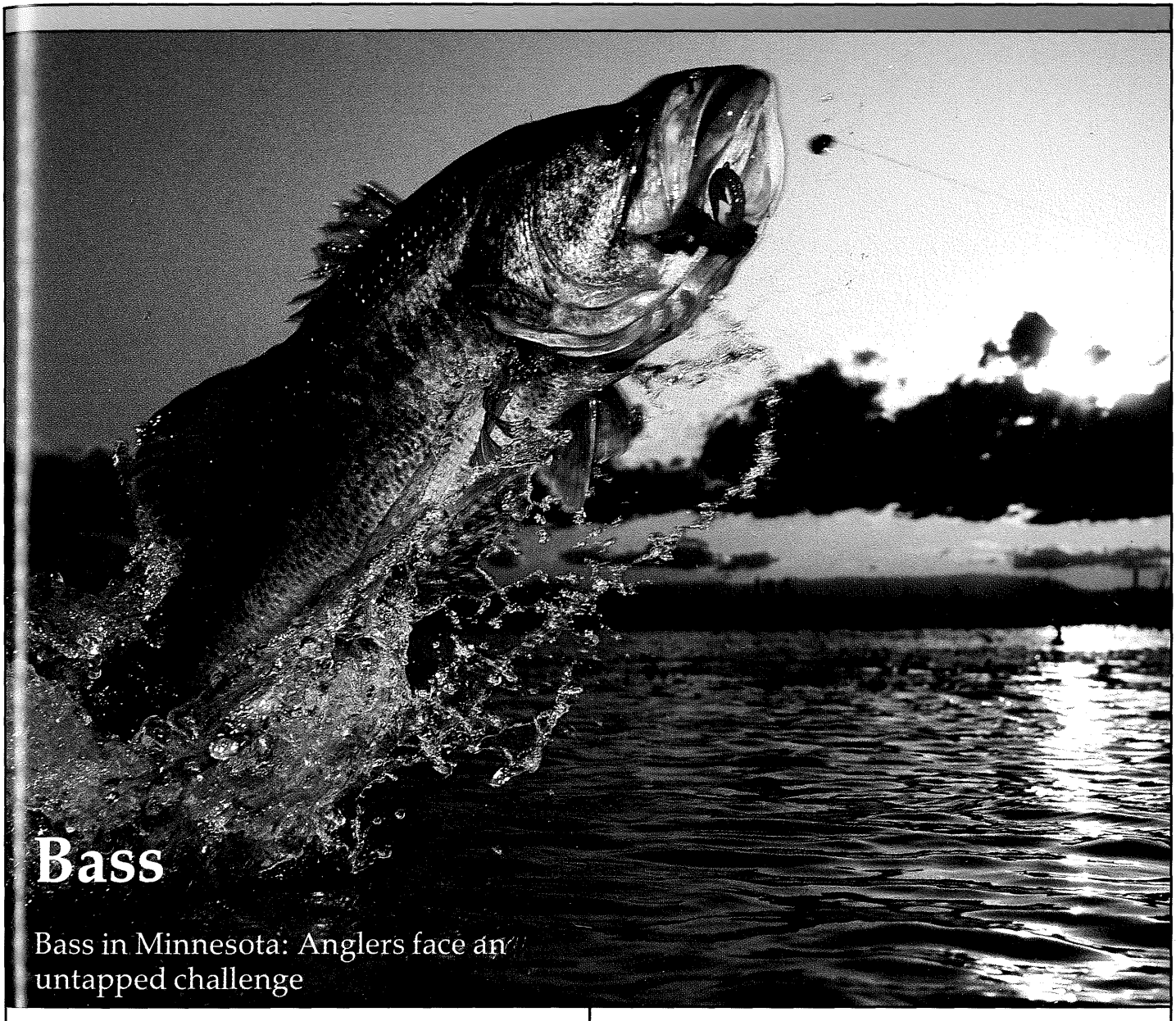


The yellow bass is limited to the backwaters of the Mississippi below Lake Pepin. The white bass is common in the Minnesota River, the St. Croix below Taylors Falls, the Mississippi below St. Anthony Falls and major tributaries, such as the Cannon and Zumbro rivers. It also occurs in reservoirs on these river systems and in several lakes in southern Minnesota. Because of its greater size and abundance, the white bass is a more important sport fish than the yellow bass. Though the following remarks apply to the white bass, they are generally true of the yellow bass as well.

White bass spawn over gravel bars in late April to June, when water temperature ranges from 55 to 79 degrees. Mass upstream spawning runs in the Mississippi and its major tributaries provide excellent fishing in April and May. The white bass is extremely prolific; a large female may lay more than 500,000 eggs. No care is given the eggs or fry, and few survive. The fish continue to swim in schools through the summer. Both species occupy rather open water, often near the surface. Adults feed on zooplankton, aquatic insects and small fish. Gizzard shad are important forage in large rivers. Individual fish may travel more than 100 miles in their seasonal movements.



White bass require little management beyond habitat protection, and aren't introduced into waters where they don't already occur.



Bass

Bass in Minnesota: Anglers face an untapped challenge

Minnesotans are beginning to discover what other anglers around the country have known for years: that the largemouth and smallmouth bass, with their jolting strikes and rambunctious leaps, are among the most exciting game fish. While walleye, northern pike and panfish remain the fish most sought by Minnesota anglers, a growing number are pursuing the widespread largemouth and its less common relative, the smallmouth. Much of this interest may stem from the rising popularity of fishing tournaments, but bass fishing takes all forms — from the bass "pro" with a high-powered, fully outfitted boat, to the wilderness smallmouth angler with an ultralight outfit and lightweight canoe.

This awakening interest in bass fishing is good and bad. On the one hand, increased angling in popular waters probably will make the bass fishing more difficult. On the other hand, fishing for bass may take pressure off more popular species, especially walleye.

Largemouth Bass Management

The keys to maintaining good numbers of desirable-sized largemouth bass are protecting habitat and regulating sport fishing.

Habitat Protection

Largemouth are adaptable and prolific. They live and successfully spawn in a variety of conditions. Being very prolific, only a few bass are required to populate a large body of water. Consequently, stocking plays a very small role in largemouth management. It is usually limited to circumstances where largemouth are being introduced to newly filled basins, winterkill lakes or chemically "rehabilitated" waters.

What is important in managing the largemouth is the protection of its habitat. Specifically, the largemouth needs the following if it is to flourish:

- **Spawning areas** with a firm bottom of sand, mud or gravel.
- **Beds of rooted aquatic weeds or other heavy cover,** such as logs, to provide protection for fry and fingerlings, and cover and ambush sites for adults.
- **Adequate dissolved oxygen,** particularly during the winter.

State law protects these kinds of habitat in a number of ways.

Shoreland zoning and related laws aid bass and other fish by controlling lake and river shoreline development that otherwise might pollute lakes with septic-system drainage. This effluent contributes to eutrophication, which decreases water clarity and dissolved oxygen. The **DNR requires that landowners first obtain a permit before working in the beds of public waters or removing aquatic weeds that provide cover.**

Various state laws limit various kinds of industrial and sewage-plant pollution that deprive fish of oxygen or poison them outright. Other forms of pollution — such as soil erosion, pesticide runoff from farmland, manure runoff from feedlots, and storm runoff from city streets and lawns — also consume oxygen and contribute to algae blooms. These "nonpoint sources" of pollution are extremely tough to correct.

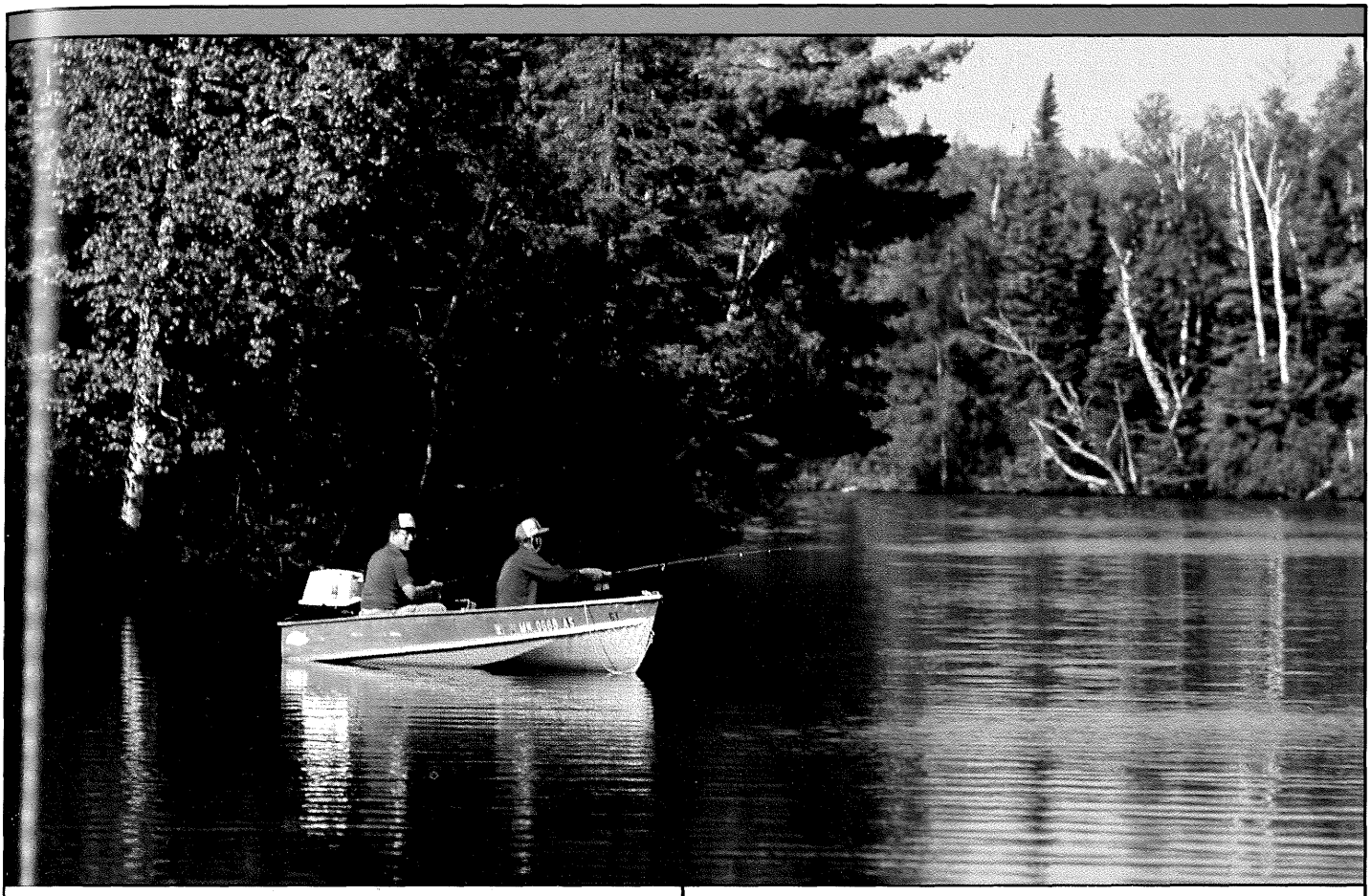
Winter aeration systems are a boon to shallow, marginal fish lakes in southern Minnesota. In the past, these lakes would lose their bass to periodic winterkill. With aeration, however, these lakes produce fast-growing bass that survive from year to year.

Regulating Fishing

Bass fishing regulations haven't changed much over the past several decades. They still have two main features: a six-fish limit, and a season opener in late May, generally when spawning is complete. (An exception is found in northeastern Minnesota, where the bass season begins with the general fishing opener.)

These regulations don't protect large bass. Heavy fishing pressure — particularly by knowledgeable, well-equipped anglers — can drive down the average size of the largemouth in a lake. Because many anglers like catching large bass and because the average size of bass affects other fish populations, fish managers are experimenting with various size regulations for largemouth bass to protect fish of a particular size.

Fish managers have found that a "slot" limit protecting all bass between 12 and 15 inches increased the average size of the bass caught and caused bass to grow faster. Among the disadvantages of a slot limit

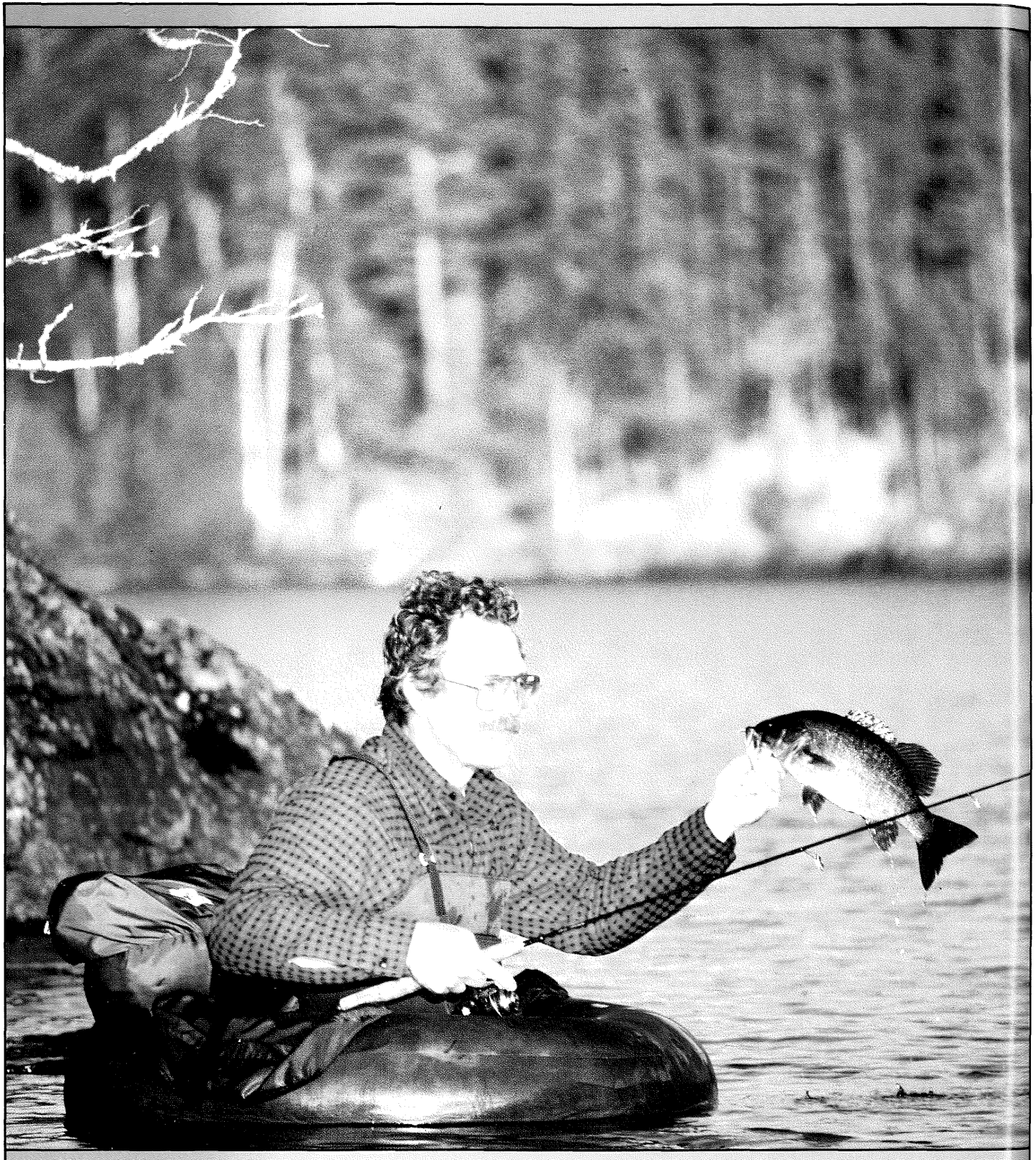


are the catch rate drops as bass become not only larger but also fewer. If the average size the of bass increases, the average size of the bluegill may decline. Why? Probably because a few large bass do not eat as many bluegill as a lot of smaller bass. So bluegill proliferate and begin to show signs of "stunting." Yellow perch, too, may figure into this complicated equation.

Another common size restriction is a minimum-size limit — 12 inches is common in many states. All bass under a foot must be returned to the water. This restriction may have begun with the common but mistaken belief that releasing small fish will produce many big fish. Actually, only releasing big fish will ensure the presence of big fish. The minimum-size limit has the opposite effect: with heavy fishing pressure, the bass population "stacks up" under the limit. This horde of small bass may not be large enough to prey on small bluegill. In some metro-area lakes, a minimum-size limit for bass of 16 inches is being tried to create a population of small and medium-sized bass in the hopes that these predators will limit the number of small sunfish and increase the number of big sunfish. The effect of this size limit on bass is of secondary concern.

Fish managers recently have begun discussing the use of special regulations to create a trophy bass fishery. Under such a plan, a high slot limit might be used to protect truly large fish. For example, 16- to 22-inch fish might be protected. Thus, anglers could keep small fish (and reduce competition) as well as an occasional trophy (a 22-inch largemouth weighs about 6 pounds.) Another approach to producing trophy bass may be a simple no-kill requirement.

The exact effects of any size restriction or other change in regulations depend on lake fertility, fishing pressure, competition from other species, condition of the forage base and other factors that must be studied lake by lake.



Smallmouth Management

Habitat

As with the largemouth, the best smallmouth management is the protection of its habitat.

Minnesota's smallmouth bass live in a variety of lakes and streams. Some waters have fared well; some have been completely destroyed as smallmouth habitat.

The lakes of northern Minnesota, including those of the Boundary Waters Canoe Area Wilderness (a nationally known smallmouth fishery), are in good health, suffering relatively little pollution. Still, acid precipitation threatens many of the lakes of the Canadian Shield. These granitic basins have little capacity to buffer the effects of acid rain. Even mildly acidic waters prevent smallmouth bass from successfully reproducing. (They are, in fact, one of the first species to be affected by acidification.) The smattering of smallmouth lakes across central Minnesota are better protected from acid rain by the greater buffering capacity of their more alkaline waters.

Smallmouth rivers have more immediate problems. The rivers of central and southern Minnesota suffer to varying degrees from poor municipal sewage treatment, farmland runoff, sedimentation from soil erosion and extremes in water level fluctuation.

Grazing livestock along bass streams causes banks to slough, increasing siltation and changing the profile of the stream channel from narrow and deep to broad and shallow. The consequences are warmer water, less dissolved oxygen, and fewer spots with the depth necessary to hold bass. Runoff from feedlots reduces dissolved oxygen and increases ammonia, killing bass and other fish.

Common pesticides, especially root-worm insecticides called organophosphates, wash off fields into streams and are particularly toxic to bass and others of the sunfish family. Biologists throughout the upper Midwest report that smallmouth bass have disappeared from many streams as corn production and insecticide use have increased. Several of the once-productive smallmouth streams in the heavily farmed Minnesota River Valley are now devoid of bass or produce only a fraction of what they once did.

Perhaps the most pervasive destroyers of smallmouth streams are the quick, intense floods and siltation caused by the drainage of wetlands (which retard runoff) and the destruction of soil cover. Heavy spring rains raise a tide of chocolate-colored waters in small streams, often at the very time smallmouths are spawning. The productive limestone streams in the steep, erodable valleys of southeastern Minnesota are particularly prone to siltation, which destroys spawning areas for bass and forage species alike.

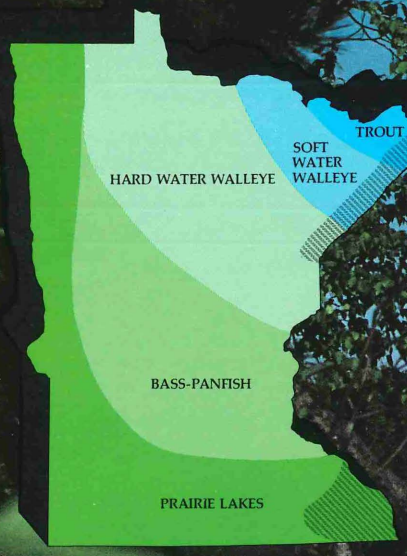
Given these environmental problems, the most important aspects of smallmouth management are the prevention of soil erosion, better containment of pesticides and feedlot runoff, the regulation of shoreline development, the reduction of acid rain, and better treatment of municipal sewage. Several agencies, including the DNR, are working toward these goals.

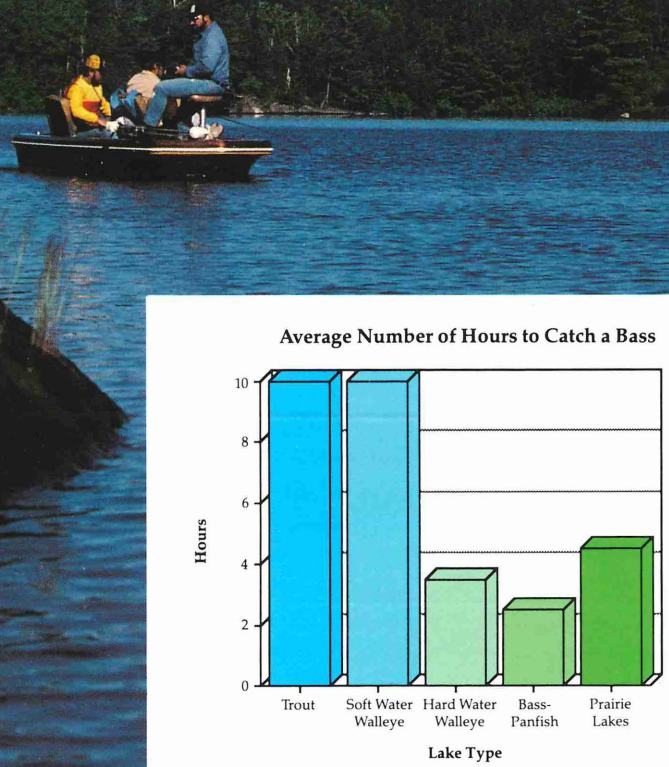
Smallmouth Stocking

As with largemouth, smallmouth are never stocked to add to an already vigorous population. Stocking is used only to introduce or reintroduce smallmouth to a body of water. A recent example in a riverine situation illustrates the difficulties in stocking.

A section of the Cannon River had lost its population of smallmouth bass. Fingerlings from a lake-dwelling smallmouth bass population were stocked in this river section but were never found again. The following year fingerlings from a nearby river were stocked into this same river section. Today, anglers are catching many nice smallmouth bass in this river section.

Ecological Types of Minnesota Waters





This is an average of all anglers and does not accurately indicate what an expert angler might catch while fishing for this species.

Fishing Pressure

As far as regulations are concerned, smallmouth have been included with largemouth. Statewide regulations protect smallmouth during the spawning season and limit the overall harvest but do little to protect large bass in heavily fished waters.

Smallmouth can be easily "overfished" for several reasons:

— Even in good smallmouth waters, smallmouth are not terribly abundant. They are never as numerous as trout are in a good trout stream, for example.

— Many smallmouth waters, such as modest-sized streams, are shallow and easily fished.

— In the fall, bass migrate considerable distances, sometimes dozens of miles downstream, and congregate in a few deep holes, where big bass can be easily caught.

An infertile area such as the Boundary Waters Canoe Area Wilderness retains its good fishing for trophy smallmouth bass because of its vast acreage and few people and because most anglers seek walleye, lake trout and northern pike rather than smallmouth. But where many anglers fish for bass, catch-and-keep smallmouth fishing can quickly drive down the average size and make big bass scarce indeed.

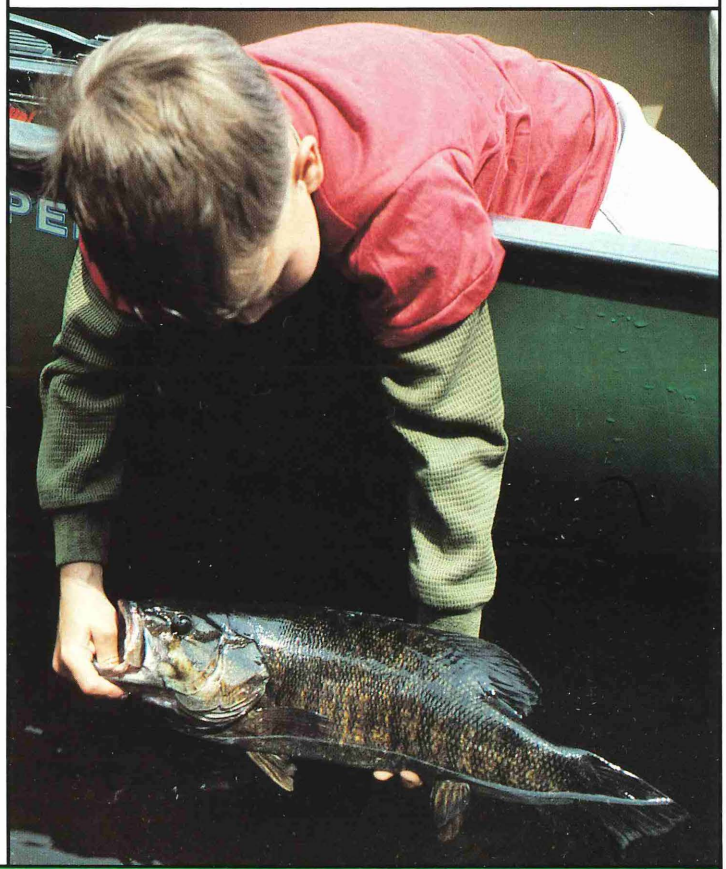
As a result, several states have used 12-inch minimum size limits to allow the fish to grow a bit before they are fried up and eaten. Nonetheless, 12-inch minimums are good at producing 12-inch fish, not 18-inch fish. And 12-inch fish are hardly trophies.

In a novel attempt to produce larger smallmouth bass on a heavily fished section of the Zumbro River, the DNR established a 9-inch maximum size limit: all smallmouth larger than 9 inches had to be returned to the water immediately. Furthermore, fishing was limited to artificials to reduce hooking mortality. Early results indicate that the special regulations increased the average size of the bass in that section of the Zumbro while letting people take some fish home. Additional experimentation and, above all, better compliance by anglers will be needed to prove the worth of a maximum size limit.

Anglers and Special Regs

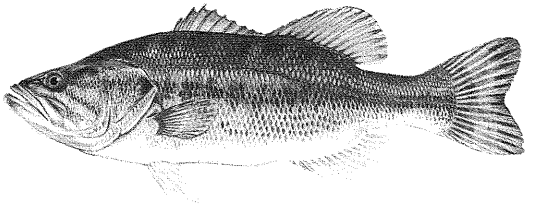
The use of restrictive size limits and other special regulations in the management of largemouth and smallmouth bass is bound to be controversial and somewhat divisive. Anglers who prize sport above a fish dinner may flock to "trophy" waters while anglers who want to keep their bass will protest attempts to impose these rules on "their" lakes. These anglers, in turn, may avoid "special-reg" waters in favor of lakes and rivers with fewer restrictions.

Unfortunately, all waters can't be all things to all anglers. This is especially true as more anglers spend more time fishing more effectively. **In the future fish managers will move away from "one-size-fits-all" regulations to a diversified sort of management that may include trophy waters, catch-and-keep waters, and other waters that feature some balance between the two.** For these regulations to work, the angler must understand and voluntarily comply with them.



Minnesota's Bass

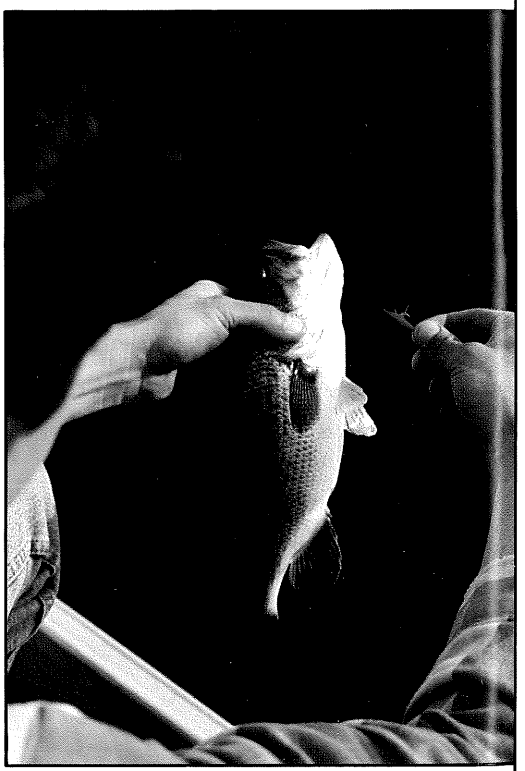
Largemouth Bass: Dark green on top with silvery green to yellow green flanks and a cream belly, the largemouth bass is marked by a dark, irregular stripe along its side. The "maxilla," or upper jaw, extends rearward of the eye. The spiny and soft portions of the dorsal fin are separated by a deep notch. Anglers routinely catch bass between 1 and 2 pounds. In Minnesota, where bass grow more slowly than they do in the South, 6-pound bass are trophies.



The largemouth lives in lakes and streams throughout Minnesota — from the backwaters of the Mississippi, to isolated potholes along the Canadian border (where it may have been stocked). It is most abundant in the small to medium-sized hard-water lakes of central, south-central, west-central and northwestern Minnesota. It is least common in the lakes of the Lake Superior drainage and the streams draining the southeastern hills.

Though the largemouth tolerates turbid water, it favors lakes with clear water, sandy shallows and abundant rooted aquatic weeds. It lives in slow streams with these same characteristics — especially streams joining good bass lakes. The largemouth is a "warm-water" species. It flourishes in waters warmer than 80 degrees and can survive temperatures in the mid-90s.

The largemouth needs water of 2 to 6 feet deep with firm sand, mud or gravel to spawn. As water temperatures near 60 degrees (between late April and early June) bass migrate from deep water toward these shallow bays and shorelines. The male moves into the spawning area first and fans out a dish-shaped nest with its tail. As the water warms to 63 to 68 degrees, a male will herd a female onto the nest, where she will lay from 2,000 to 7,000 eggs per pound of body weight. The male then fertilizes the eggs.



After spawning, the female moves off into deep water and does not feed for a couple of weeks. The male guards the nest until the eggs hatch and mature into a swarm of black fry. During this time, the male strikes savagely at intruding fish (or lures) but does not eat. It may even carry intruders and objects from the nest but then ejects them. When the fry reach an inch in length, they leave the nest. Then the male resumes feeding and in fact may eat any young bass he encounters.

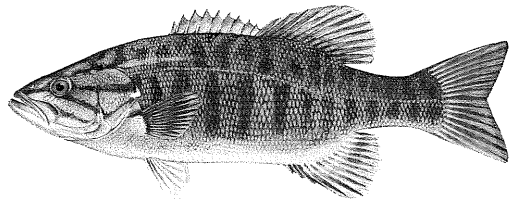
Largely because of the male's fastidiousness in building and guarding the nest, many fry survive, and a few adult bass can quickly populate new waters. In fact, researchers have found no correlation between the number of spawning bass and the subsequent number of young-of-the-year fish. The success of the spawn depends entirely on good spawning areas and stable weather. A severe cold front, for example, may cause the male to desert the nest. Then the eggs or fry can be eaten by other fish.

As the water continues to warm after the spawn, largemouth spend much of their time in the shelter of thick cover or deeper water. During the summer, they typically feed in the shallows during evening and early morning.

Largemouth fingerlings feed on increasingly larger invertebrates and soon add small minnows to their diets. Adults eat minnows, yellow perch, sunfish and large invertebrates, such as crayfish and dragonfly nymphs, as well as any small terrestrial creature hapless enough to tumble into the water.

Largemouth feed largely by sight, but also use smell and their ability to feel vibration through their "lateral line," a sense organ that runs longitudinally down their sides. In one experiment, reseachers released minnows into a tank holding several largemouth bass that had been "blindfolded" with eye patches. The bass were able to locate the minnows through vibration alone and intercept them one by one.

Smallmouth Bass: Sometimes called a "bronzeback" for its brassy brown hue, the smallmouth differs from its cousin in several ways. Its mouth, though hardly small, is no match for the largemouth's; the maxilla extends rearward only about even with the pupil. The notch between the spiny and soft parts of the dorsal is less pronounced than the largemouth's. The smallmouth's markings consist of irregular vertical bars or a continuous shading of dark brown above to a gray or cream below. The average hook-and-line smallmouth ranges from 1/2 pound to 1-1/2 pounds. A 5-pounder is exceptional.



The smallmouth is native to the Mississippi watershed. It is abundant throughout the limestone streams of the Root and Zumbro drainages that are too warm to support trout. It is found in the bouldery tributaries of the Mississippi in central Minnesota (such as the Rum), and throughout the St. Croix and its tributaries (such as the Kettle and Snake). The Mississippi itself holds large smallmouth bass as far north as Brainerd. Farther north, river smallmouth become increasingly scarce, though they occupy stretches of the St. Louis, Cloquet and Whiteface rivers.

The smallmouth also is native to many central Minnesota lakes, though it is far less common in this environment than the largemouth. The keys to their presence in these waters are clear water and suitable spawning gravel and rubble.

During the late 1800s, smallmouth were valued nearly as highly as trout and salmon and were transplanted to new watersheds with great fervor but little accurate record keeping. So biologists have been left to study historical records and postglacial drainage patterns to determine the presettlement range of the fish. Smallmouth bass probably are not native to the lakes that provide some of the best

smallmouth fishing in the state, including Lake of the Woods, Rainy, Namakan, Vermilion and the large border lakes of the Boundary Waters Canoe Area Wilderness.

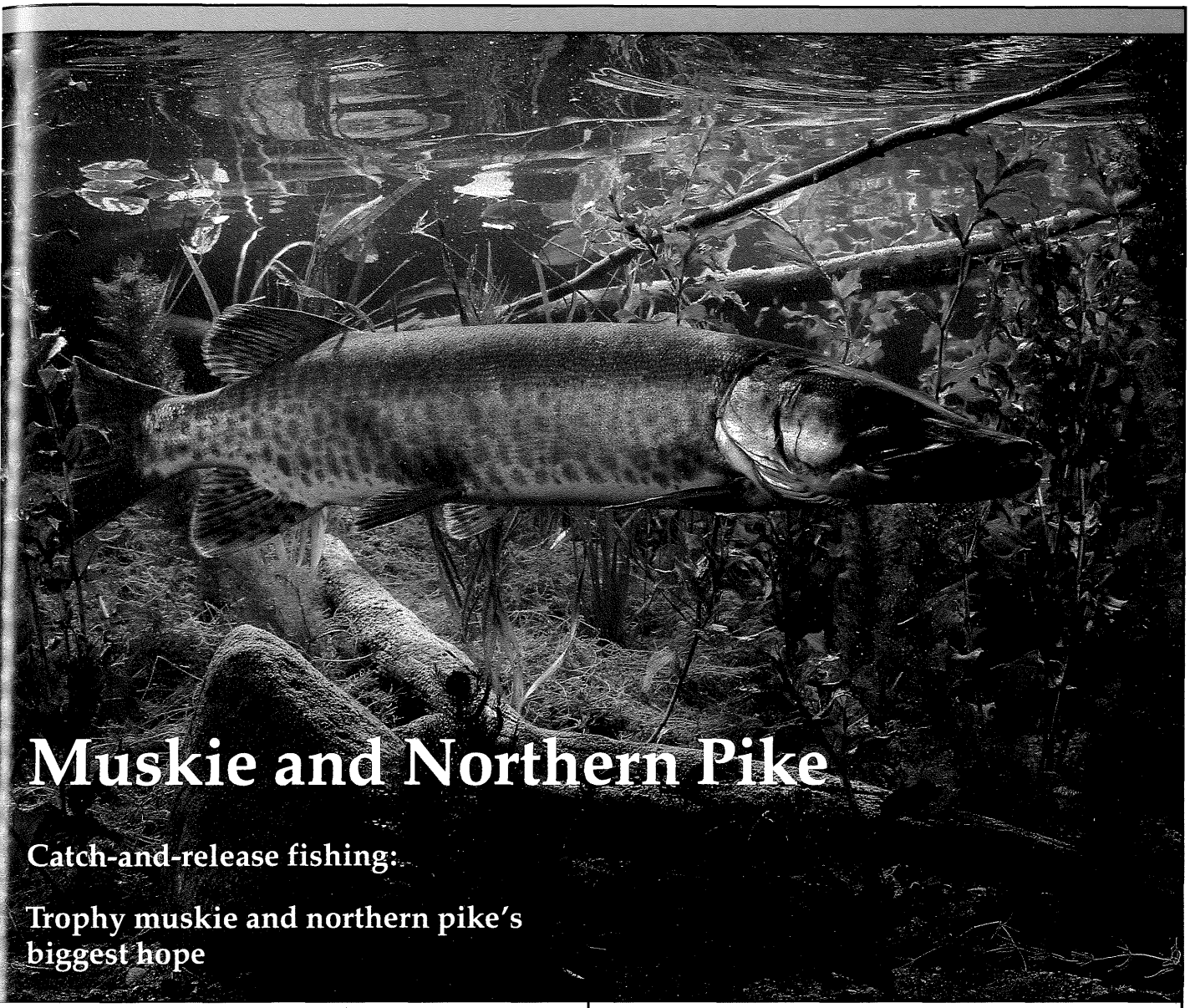
Though smallmouth flourish in many Minnesota lakes, they are primarily a creature of rivers. Whether smallmouth live in moving water or still, they are usually found next to rocks. In particular, smallmouth prefer gravel from pea size to 1 inch in diameter to build their nests and spawn. Water temperatures must reach the low 60s for smallmouth bass to spawn, which is one reason many cold-water streams hold trout rather than bass. On the other hand, smallmouth shun waters that commonly exceed the mid-80s. Temperatures over 90 degrees are lethal. Smallmouth also need a great amount of dissolved oxygen and, in streams, a dependable streamflow and modest current.

In the spring bass disperse to their spawning areas in gravelly shallows of lakes or large, gentle eddies in streams. The male builds the nest. The female lays 2,000 to 10,000 eggs and then heads for deep water. The male remains on the nest two weeks or more, guarding eggs and fry.

As with the largemouth, research on smallmouth has shown no relationship between the number of spawning fish and the success of the spawn. The strength of the year class depends solely on water conditions — in particular, the absence of a sudden cold snap or muddy floodwaters that can kill eggs and fry.

Once the fry have left the nest, male and female bass resume feeding. In streams, the larger fish move between sheltering lies (usually in pools or near heavy cover) to feeding lies near current (such as eddies or riffles), where they feed on small fish and large invertebrates, especially crayfish. Lake fish feed in the shallows but spend more and more time in deep water as summer progresses.

Recent studies in northern latitudes have revealed that stream smallmouth may migrate much more than previously supposed. In the fall, as the water temperature drops below 60 degrees, smallmouth may migrate 50 miles or more, moving a dozen miles in a single day, to find their ''hibernacula.'' These winter resting areas may be deep pools in a stream, or bass may desert a creek entirely, finding refuge in a larger river. There they crowd together and remain lethargic and eat little through the winter.



Muskie and Northern Pike

Catch-and-release fishing:

Trophy muskie and northern pike's biggest hope

The muskellunge is revered as one of Minnesota's great game fish. It is big. It is powerful. It is elusive and rare. It is capricious and difficult to catch. It strikes savagely and fights strongly — often spectacularly — ripping out line and frequently leaping from the water. It is a fish worthy of obsession. A few anglers dedicate themselves to its capture, spending hundreds of hours in pursuit of a trophy fish. And when a muskie fanatic catches such a lunker, more than likely he lets it go. In doing so, preserves his sport and the sport of others.

Consider, now, the northern pike. Like its close relative the muskie, it is a big, powerful predator capable of slashing strikes and tremendous fight. Under proper conditions, which Minnesota has in abundance, the northern pike grows nearly as fast and nearly as large as the muskie. Furthermore, it is far more common and much hardier. Yet, small northern pike are so common and eager to bite that they are often disparaged as ''snakes'' or ''hammerhandles,'' and the northern pike in general is rarely accorded the respect given the muskie.

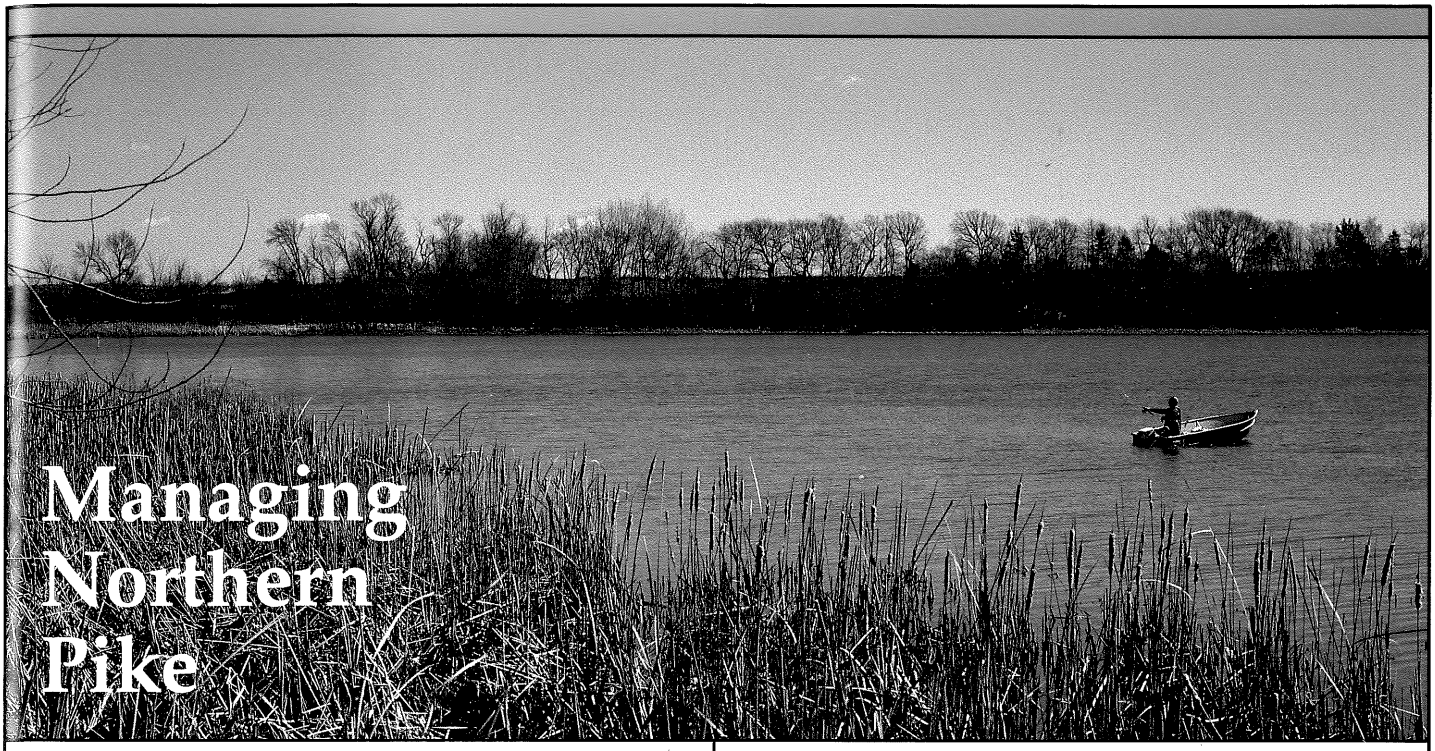
Why?

Partly it is due to the muskie's rarity. But probably for more than any other reason, the muskie is revered because it is big — really big. It easily can exceed 30 pounds, and anglers commonly catch fish in excess of 10 pounds. Northern pike, on the other hand, average much smaller: 2 to 3 pounds. While northern pike can get quite large, they rarely do. The reason they don't, according to many fish managers, is largely a result of heavy fishing pressure.

Northern pike don't reach their potential as trophy fish because in their eagerness to strike a lure they are plucked from a lake and filleted before they reach trophy size. Muskie have been protected by a catch-and-release ethic and a large minimum-size limit — a muskie isn't even a legal "keeper" until it reaches about 12 pounds. Northern pike however have been given no such protection. They have been managed according to what might be called a "many-small-fish" policy. Such an approach provides a lot of fish, which pleases anglers who are glad to catch anything, but it has limited the northern pike's potential as a trophy fish.

Nonetheless, the DNR's policy toward northern pike management is changing — not on all waters, but on a selected few that are suitable for large fish.

Let's examine how northern pike and muskie have been managed in the past and how northern pike management may change to create a greater diversity of fishing opportunity.



Managing Northern Pike

Habitat

Minnesota may be known as the walleye state, but the truth is, the northern pike is its most widespread game fish. In fact, with its abundance of marshy lakes and streams, Minnesota has as much or more northern pike habitat than any other state.

Good habitat is the key to producing northern pike. Given relatively clean water, adequate forage, and abundant shoreline marshes and wetlands for spawning; northern pike will proliferate without further help.

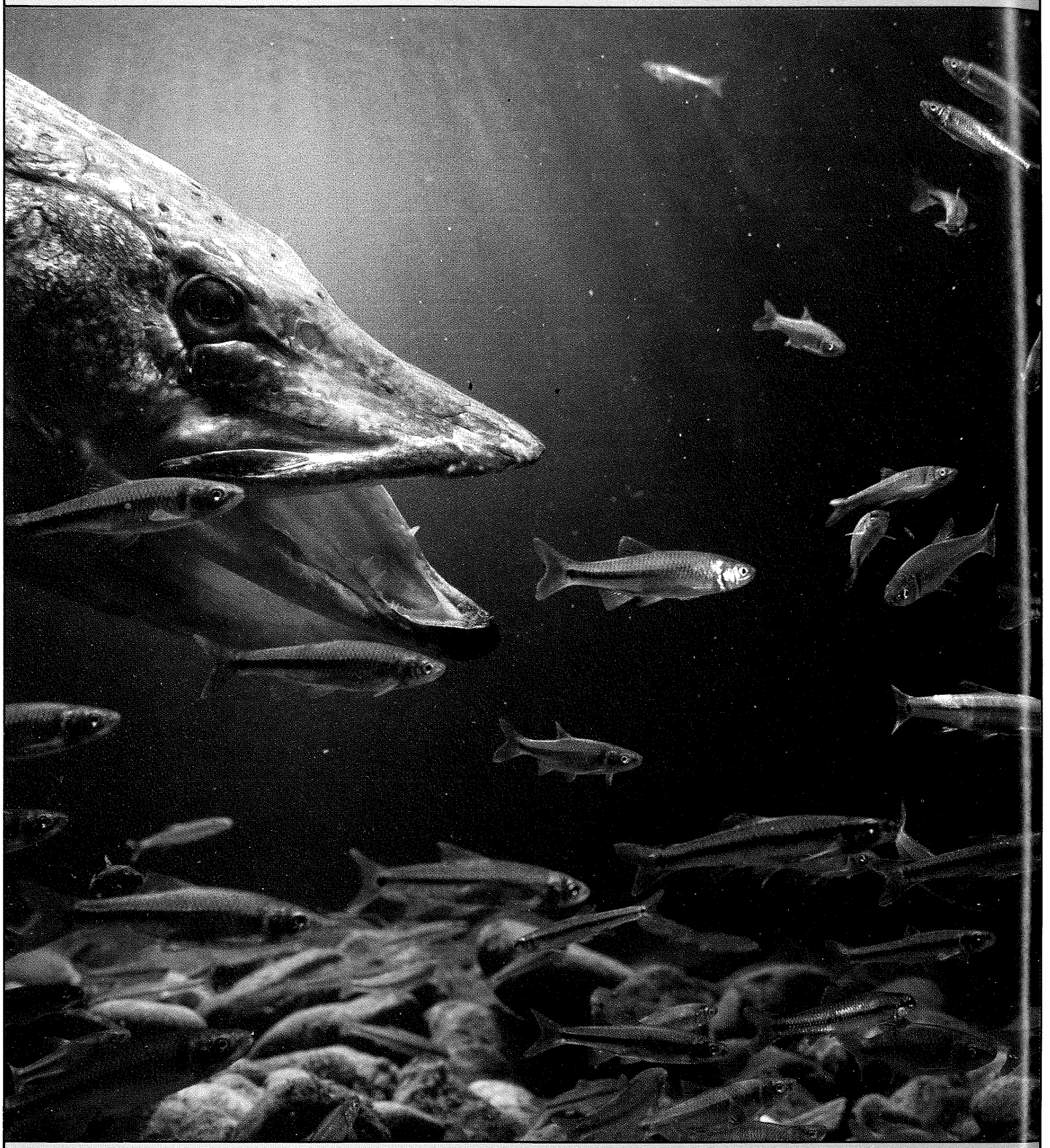
Many northern pike spawning areas have been lost to drainage, dredging and shoreline development. They are destroyed by the farmer who drains a seasonally flooded wetland adjoining a stream or lake, and by the cabin owner who kills the cattails along the shore of a shallow bay. These areas must be protected through shoreland regulations that prevent draining, filling and other destruction of shoreline wetlands. Also important are regulations that prevent wholesale removal of the shallow-water aquatic weeds that provide cover to young northern pike and their prey.

Where northern pike spawning areas are lacking, a fish manager can create habitat by building a low dam to flood low-lying land near a lake. The area fills with spring runoff, the northern pike spawn and the fry grow to fingerlings. They then escape or, if there is a barrier between the lake and spawning area, are released to the main body of water.

Stocking

Northern pike stocking isn't often undertaken on a large scale and is easily overdone. Research has shown that in a lake with a naturally abundant northern pike population, few of the stocked fish are caught by anglers. So, stocking northern pike often is a waste of time and money. Moreover, a recent Minnesota study has shown that continued stocking of northern pike can hurt other game fish and panfish populations.

Thousands of northern pike a foot long and larger were stocked in Horseshoe Lake in Crow Wing County three times during the 1970s. The northern



pike ate perch of all sizes, nearly eliminating spawning-sized fish. Bass and walleye found fewer perch to eat. Bluegill, in turn, seemed to fill the niche once occupied by perch. The result of this chain reaction was the near disappearance of yellow perch, smaller and fewer largemouth bass and walleye, and a proliferation of stunted bluegill. By almost any measure, whether for walleye, bass or panfish, the fishing deteriorated. Only the northern pike population benefited — and it too, declined only two years after stocking. Other fish populations, meanwhile, required many years to recover to natural levels.

Controlling Panfish

Big northern pike eat large fish and a lot of fish, and so fish managers long thought that an abundance of northern pike would limit panfish numbers, preventing the "stunting" common in many lakes.

As in Horseshoe Lake, stocking northern pike to control panfish can backfire. In fact, we have little evidence that an abundance of northern pike (or muskie) can prevent a proliferation of small sunfish. Apparently, sunfish are too prolific and too adept at hiding in thick cover to be controlled by northern pike. There also is evidence that northern pike prefer cylindrical fish such as perch and tullibee rather than the saucer-shaped sunfish.

Growing Big Northern Pike

Everyone likes to catch big northern pike. But why do most lakes carry an abundance of small fish and only the rare body of water hold fair numbers of truly large northern pike?

What is needed to grow big northern pike?

A lake must have adequate spawning areas to produce a self-sustaining northern pike population. There is little evidence, however, that a superabundance of northern pike fry has any effect on the size to which northern pike ultimately grow.

Northern pike must have adequate forage — primarily minnows, perch, suckers, tullibee and other fish of appropriate size. **They also must have cool, well-oxygenated water to grow well.** Northern pike are a "cool-water" species, and research indicates that they stop feeding and may even lose weight in the warm water and occasional low-oxygen conditions prevalent in midsummer. So, if a lake is to grow big northern pike, it must have a cool-water refuge, such as deep, well-oxygenated water, with a suitable cool-water forage fish, such as tullibee.

Finally, big northern pike must have protection from anglers. No northern pike ever grew large in a Pyrex baking dish. Large northern pike simply are too few to endure heavy fishing pressure. Big fish must be protected by remoteness, as they are in the Canadian wilds and the remoter waters of northern Minnesota, or by some form of catch-and-release regulations so that most big fish are returned to the water to grow even larger. Restricted harvest is the management approach we've taken toward muskie, and that is the approach we must take if we want to grow really large northern pike in the presence of heavy angling pressure.

Recently, anglers and fish managers have begun discussing the use of special regulations to create good fishing for large northern pike. These regulations may take several forms.

A pure no-kill restriction would most closely replicate the conditions that exist on remote lakes that are fabled for their large northern pike.

In some lakes, the DNR has increased the possession limit and imposed size restrictions to encourage anglers to take more small fish. The hope is that through decreased competition, the remaining fish will grow larger. In other lakes, the DNR has banned spearing to protect the large northern pike that otherwise might fall prey to that method of fishing.

Some biologists believe a slot length limit or maximum-size limit will protect large fish and create a trophy fishery. Meanwhile, anglers could keep some small fish, which are common in most lakes anyway.

What is necessary for Minnesota to steer toward a "big-northern-pike" policy on select waters where northern pike can grow large? Anglers will have to stand up for such a policy. They will have to convince other anglers that catching and recatching big northern pike is worth more than killing and eating big northern pike.

Managing Muskie

The muskie long has been recognized as special — a large, rare trophy. Its habitat requirements are more particular than that of its close relative, the northern pike. In many areas, the muskie's existence is rather tenuous — threatened by fishing, habitat loss, and competition from other fish species. So the goal of muskie management is to create or protect self-sustaining populations and to produce a few large fish for the angler skilled and dedicated enough to catch them.

Habitat Protection

In lakes where the muskie is native, the protection of habitat — especially spawning areas — is the key to protecting these fish. Removal of shoreline and aquatic vegetation denies the muskie cover it needs. Eutrophication from farmland and residential development hurts spawning success by consuming oxygen along the riverbed or lake bottom, where the eggs of muskie and some forage fish incubate.

Drainage of wetlands causes siltation and exaggerates the effects of flooding and drought — all to the detriment of muskie. Increased turbidity makes foraging harder for the sight-feeding muskie.

Stocking

The DNR normally doesn't stock muskie in lakes and rivers where they are native and self-sustaining. It simply isn't necessary or effective. Stocking is used instead to create new muskie fisheries.

The DNR introduces muskie only to lakes that seem particularly well suited to them. An ideal lake has adequate forage, no chance of winterkill, suitable spawning areas and a size exceeding about 500 acres. Muskie then are stocked as fingerlings. If natural spawning areas are limited, stocking will continue on a regular schedule. Ideally, however, the population will become self-sustaining.

Fish managers have begun paying much more attention than they once did to the genetic origins of the muskie they stock. Several strains of the fish have evolved in different regions and watersheds. Some grow larger than others, which is of interest to the angler. More important, however, is that the adaptations of some strains allow them to better survive in certain habitats. For example, the muskie of Leech Lake and elsewhere in the upper Mississippi basin has evolved to coexist with northern pike, apparently by spawning in areas different from "classic" northern pike and muskie spawning habitat.

Efforts to stock muskies to control stunted panfish populations generally have failed. Muskies seem as ill-suited to the task as do northern pike. When muskies were introduced to one Wisconsin lake, the number of largemouth bass dropped. The number of yellow perch increased while their size decreased. Muskie actually appeared to contribute to the problem they were thought to correct. In another Wisconsin experiment, muskies were stocked in a lake filled with runty bluegill. Though the muskie fattened up quickly, the bluegill population showed no effect.

Trophy Management

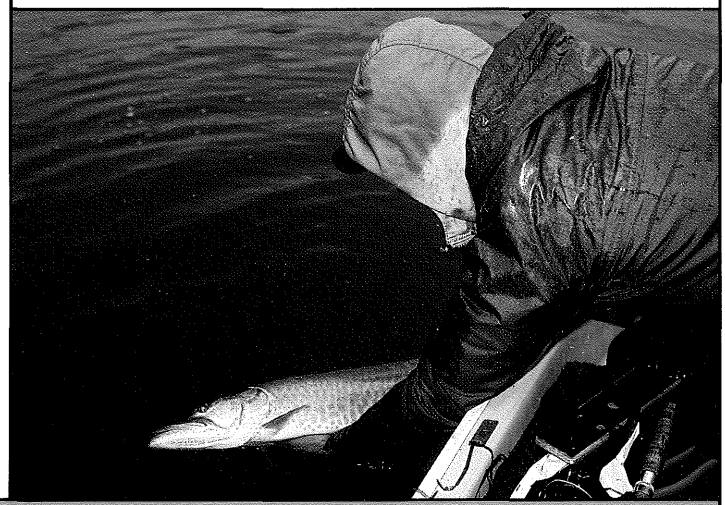
Because muskie are perceived as trophies — and because large fish are scarce and old — most states impose a minimum-length limit and low possession limit. In Minnesota, the possession limit is one and the minimum length varies from 30 to 40 inches, depending on the water.

While Minnesota allows spearing of northern pike, it bans the practice on many lakes where muskie might be accidentally speared.

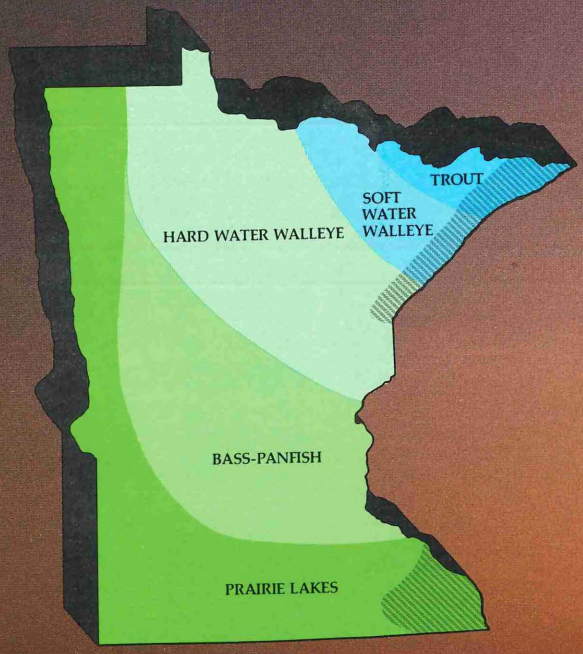
Serious muskie fishermen are doing far more for their sport than the law requires, voluntarily releasing nearly all their fish, even those larger than the size limit, to be caught again. In the words of ichthyologist George C. Becker, "catch-and-release programs work by offering more fishing fun, and by providing the moral satisfaction that comes with leaving something for the next fisherman rather than contributing to the exhaustion of an already strained resource."

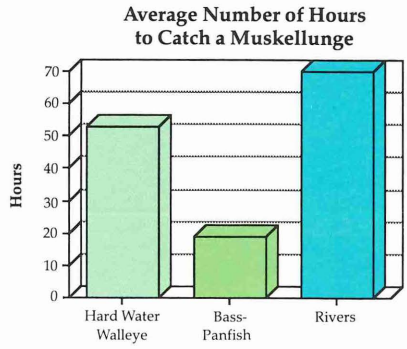
No matter how lovingly we treat the muskellunge, it is destined to remain uncommon and hard to catch. Its biology guarantees that. But with proper management, the occasional trophy will continue to thrill the dedicated muskie angler.

- 50 inches or greater is a trophy muskellunge.
- Virtually no male muskellunge reach 50 inches in length.
- 45-49 inches is a trophy male muskellunge.
- Most 50-inch muskellunge are 15 years or older.

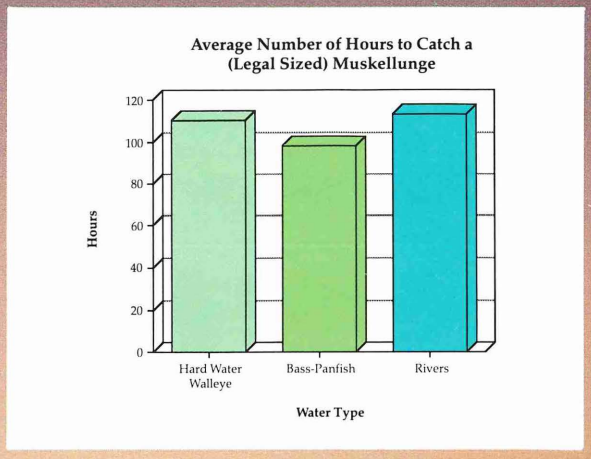


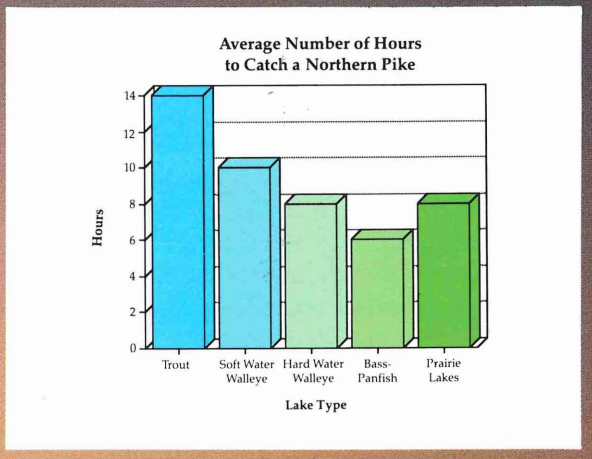
Ecological Types of Minnesota Waters





These bar charts are an average of all anglers and does not accurately indicate what an expert angler might catch while fishing for these species.


Average Number of Hours to Catch a (Legal Sized) Muskellunge
Hours
120
100
80
60
40
20
0
Hard Water Walleye
Bass-Panfish
Rivers
Water Type


Average Number of Hours to Catch a Northern Pike
Hours
14
12
10
8
6
4
2
0
Trout
Soft Water Walleye
Hard Water Walleye
Bass-Panfish
Prairie Lakes
Lake Type

Minnesota's Trophy Fish

Northern Pike: The northern pike is popular because of its size and willingness to strike a bait or lure. Angler-caught fish average 2-3 pounds, though northern pike occasionally exceed 20 pounds. The northern pike occurs in nearly all Minnesota's lakes and streams except for the lower reaches of the North Shore creeks and the well-drained watersheds of the southeast.

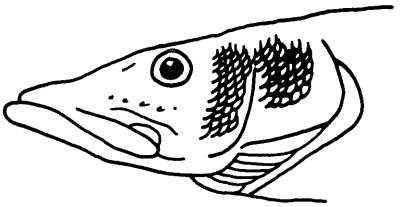
The following northern pike features distinguish it from the muskie: light markings on a dark green background; lower half of the cheek completely scaled; five or fewer pores on each side of the underside of the jaw; and rounded tail tips. An uncommon variant called the silver pike is dark silver or greenish gray, rather like the "clear" coloration of the muskie; yet it is a northern pike and has the northern pike's scale and pore pattern.

Northern pike spawn in late March to early May. Though they occasionally lay eggs under the ice, they usually begin moving into small streams and flooded marshes when the water temperature is 39 to 52 degrees. Females deposit up to 100,000 eggs at random. The adhesive eggs stick to flooded vegetation for about two weeks before hatching. Northern pike fry feed on plankton and then invertebrates but soon switch to a diet consisting largely of fish.

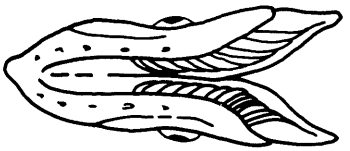
Built for quick acceleration, they ambush prey from cover, seizing fish with needlelike teeth. Northern pike can't afford to expend that amount of energy in pursuit of morsels; so they concentrate their efforts on larger forage. Indeed, they often swallow fish a third their own length. Common foods are yellow perch, tullibee, suckers, minnows and other northern pike. Though northern pike eat sunfish and bass, they prefer more cylindrical fish. Northern pike also eat leeches, frogs and crayfish.

Small northern pike remain in shallow weedy water through much of the year. Large northern pike move deeper as summer progresses, seeking oxygenated water of 65 degrees or cooler. Large northern pike become lethargic in warm water, eating little and sometimes losing weight. (In prolonged high temperatures and low oxygen, northern pike may actually starve.) Moreover, in midsummer forage reaches peak abundance. For these reasons northern pike fishing falls off in warm weather.

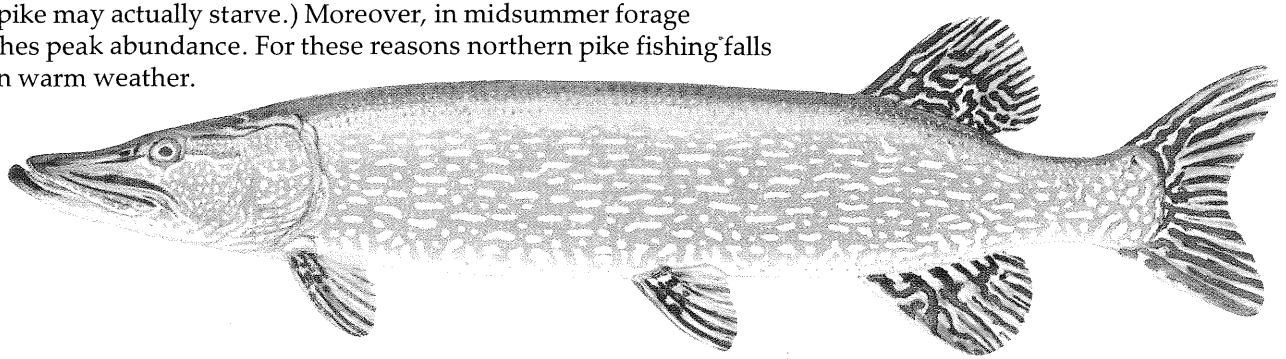
Northern Pike



Scales cover cheek and upper half of gill cover



Pores on lower surface of jaw five or less on each side



Muskie: The muskellunge is native to Lake of the Woods; lakes of the Upper Mississippi drainage (such as Cass and Leech lakes and the Boy River system); a few smaller lakes near Grand Rapids and Park Rapids; and the Rainy, Big Fork, Little Fork, St. Croix and Mississippi rivers. It has been introduced to about 50 lakes.

The muskie, unlike the northern pike, has six to nine pores (usually seven) on each side of the underside of the lower jaw. The lower half of the muskie's cheek is not scaled. The lobes of the muskie's tail are more pointed than those of the northern pike.

The muskie's coloration, too, is distinct from a northern pike's and takes three common forms that depend somewhat on the muskie's place of origin, but all have a light background.

Most muskie from the upper Mississippi watershed and the Big Fork, Little Fork and Rainy rivers have dark spots on a light background. Muskie from the Park Rapids area and Shoepack Lake in Voyageurs National Park (as well as many Wisconsin waters) usually have dark bars on a light background. The Shoepack strain was widely stocked until it was discovered to be a rather small fish, even when raised in waters suited for rapid growth.

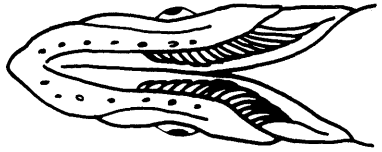
The third pattern, which is occasionally seen throughout Minnesota and Wisconsin, is the "clear" pattern of light sides with no marks or very faint marks on the rear third of the fish.

The muskie spawns when the water temperature is 48 to 59 degrees, about two weeks later than the northern pike. A 40-pound female can produce more than 200,000 eggs. They generally spawn twice, the second time about 14 days after the first time. Unlike the northern pike's adhesive eggs, which cling to vegetation, the muskie's eggs settle to the bottom. Some muskie spawn in streams and shallow bays with marl bottoms, rather than the weedy in-shore areas northern pike use. This separation of spawning areas apparently prevents northern pike fingerlings from preying on newly hatched muskie fry. In other circumstances, however, late-spawning northern pike have been observed actively spawning with muskie; the hybrid offspring is called a "tiger muskie."

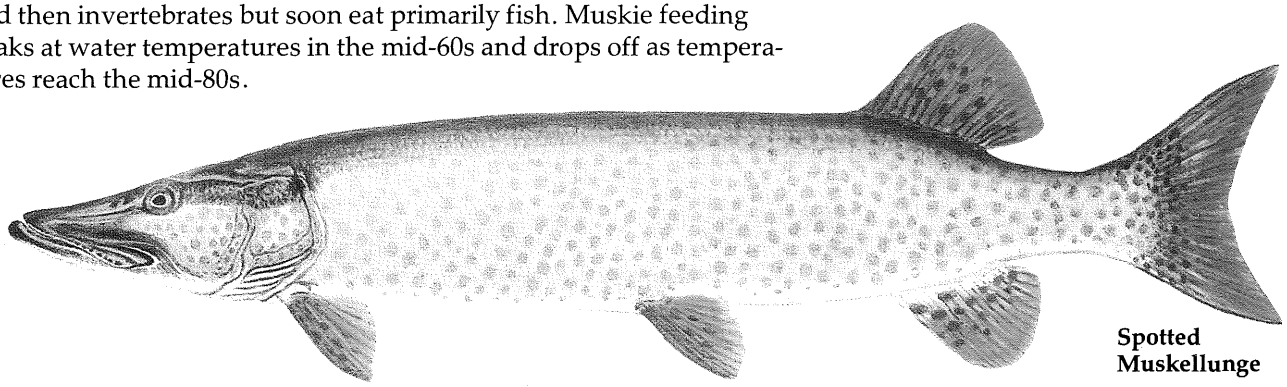
The muskie's diet is similar to the northern pike's. Fry eat plankton and then invertebrates but soon eat primarily fish. Muskie feeding peaks at water temperatures in the mid-60s and drops off as temperatures reach the mid-80s.

Muskellunge

Scales on upper half of cheeks and gill cover



Pores on lower surface of jaw more than five on each side



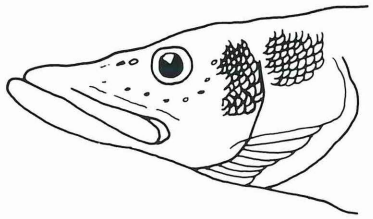
Spotted Muskellunge

Muskie are smaller than northern pike during their first couple years but later grow longer and heavier than their relatives, occasionally surpassing 30 pounds. The average angler-caught muskie is much larger than the average northern pike. Genetics plays a role in this size difference. So do fishing regulations that protect muskie with a minimum-size limit but allow a liberal harvest of small to medium-sized northern pike.

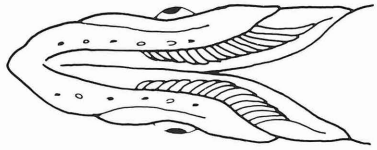
Tiger Muskie: The tiger muskie is the hybrid of the northern pike and muskie. It is usually infertile and has characteristics of both parents. The hybrid has distinct tiger bars on a light background, similar to the barred coloration pattern of some muskie. Its fins and tail lobes are rounded like a northern pike's but colored like a muskie's. The cheek-scale and mandible-pore patterns are intermediate between a northern pike's and muskie's. The tiger muskie grows slightly faster than either pure-strain parent in the first several years of life. It can exceed 30 pounds. Some tiger muskie occur naturally, though most hybrids are produced in hatcheries. They are useful in stocking because they grow quickly and endure high temperatures better than either parent does. Hybrids are easier to raise in a hatchery than pure-strain muskie, they reach legal size sooner and they are easier to catch. Because tiger muskie are usually sterile, their numbers can be controlled by changing the stocking rate.

In Minnesota, fish managers use the pure-strain muskie in lakes that can sustain naturally reproducing populations. The tiger muskie is reserved for lakes with heavy fishing pressure in and near the Twin Cities. Tiger muskie are subject to the same low possession limit and minimum-size limit that protect pure-strain muskie.

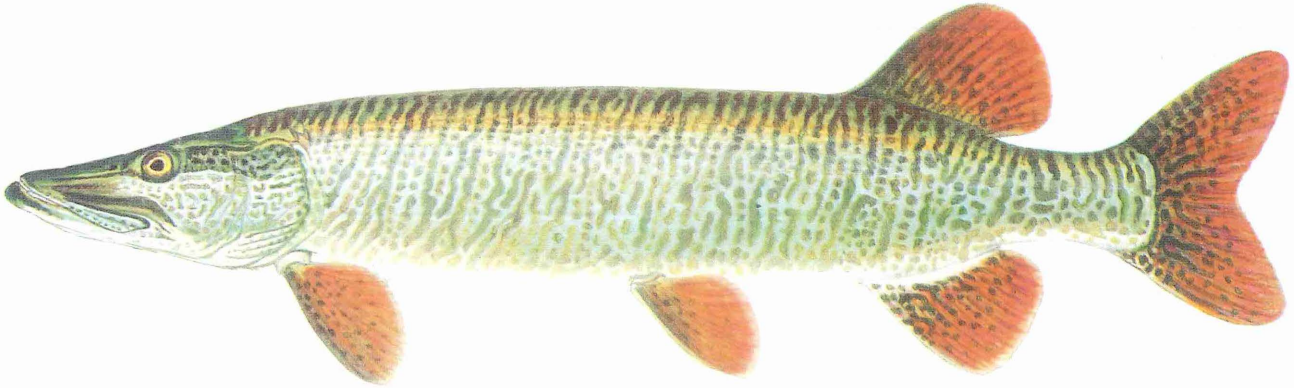
Tiger Muskellunge



Scales cover most of the cheek and upper half of gill cover



Pores on lower surface of jaw five to seven on each side



Northern Pike vs. Muskie

Minnesota's muskie apparently have evolved to avoid head-on competition with northern pike.

If northern pike find their way into muskie water, they seem to proliferate at the expense of muskies.

Why does the northern pike compete better? That question continues to puzzle fish biologists, though many believe that the earlier-hatching northern pike prey on newly hatched muskie if the two species use the same spawning areas.

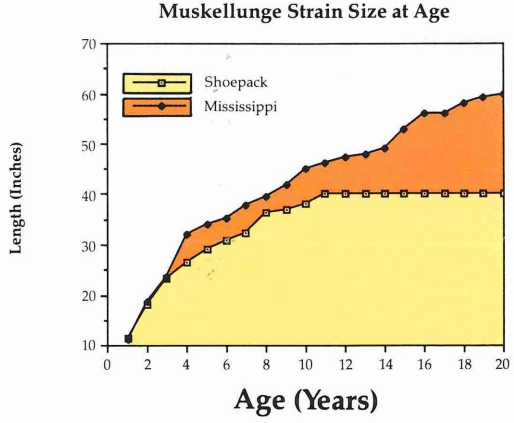
In waters where muskie evolved without northern pike present — such as the Park Rapids area lakes, Shoepack Lake and much of Wisconsin — the muskie chooses the same weedy, flooded wetlands that serve as northern pike spawning areas elsewhere. If pike are introduced to these lakes, as they have been in many Wisconsin drainages, the northern pike spawn in these same areas — but about two weeks earlier. So when the muskie fry hatch, they may be eaten by the larger young-of-the-year northern pike.

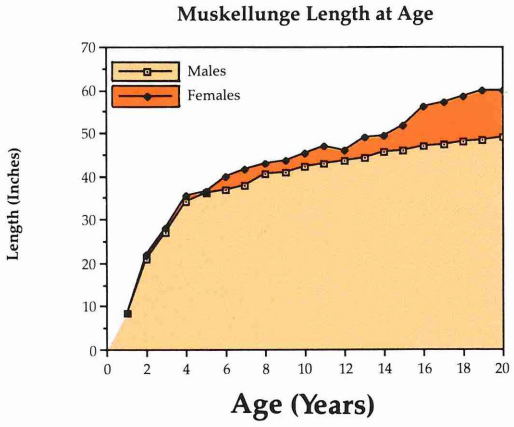
To make matters worse, young muskie routinely hang just below the surface of the water, where they are easy prey for birds from above or fish from below.

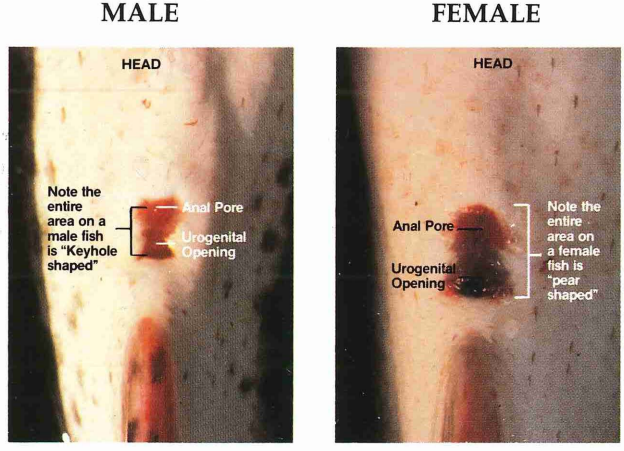
Where the two species have coexisted for thousands of years, as they have in the Mississippi River headwaters, the muskie seem to have adopted different spawning areas. In Leech Lake, for example, muskie spawn offshore in 3 to 6 feet of water. Northern pike, meanwhile, use the weedy shorelines of bays and presumably have less chance to prey on the muskie.

Other evidence suggests that riverine conditions help muskie hold their own against northern pike, which prefer slower, weedier water. Indeed, among the areas in Minnesota where muskie and northern pike coexist are the Rainy, Big Fork, Little Fork, St. Croix and Mississippi rivers.

Researchers have speculated but haven't proved that northern pike-muskie competition may be affected by other factors, including disease, dissolved-oxygen concentrations, water-temperature fluctuations at spawning time, and prevailing water temperatures.





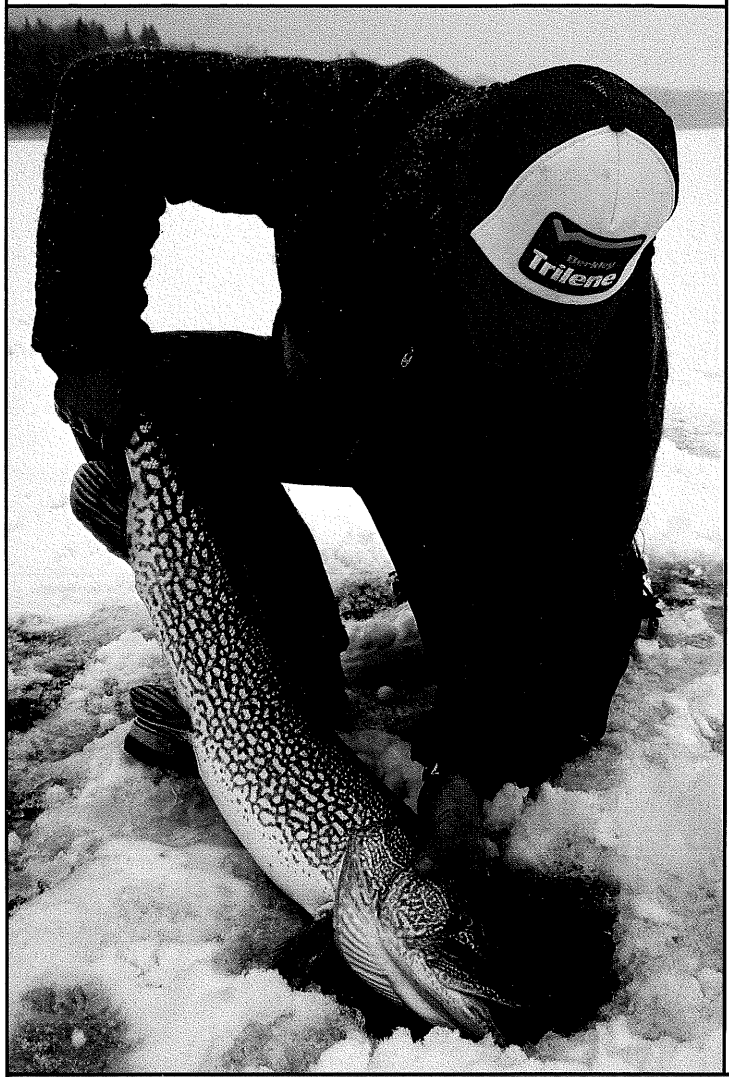


The urogenital opening is used to externally sex muskellunge. The left one is a male (keyhole shaped) and the right, a female (pear shaped).

Successful Catch-and-Release

Careful handling makes catch-and-release work

A big muskie is an old muskie. Females require 14 to 17 years to reach 30 pounds. Northern pike grow even more slowly. Once taken out of the water and hung on a wall or carved into fillets, a trophy is not soon replaced by another fish of its size. So, the key to creating trophy northern pike and muskie fishing is catch-and-release angling. Unfortunately, some fish are mortally injured by improper handling and cannot be successfully released.



All northern pike and muskie are difficult to handle because of their slippery hides, lack of good handles and sharp teeth. Big fish are particularly troublesome because of their great size and power.

The first step to successfully releasing fish is to use artificials rather than live bait.

The second step is to keep the fish in the water if at all possible.

Caught on artificials and handled carefully, nearly all fish can be returned with no permanent injury. Here are some effective methods, courtesy of Muskie Canada, for handling large northern pike and muskie:

— Hand release. Grip the fish over the back, right behind the gills (never by the eye sockets!) and hold it without squeezing it. With the other hand, use a pliers to remove the hooks, while leaving all but the head of the fish in the water. Sometimes hooks can be removed with the pliers only; the fish need never be touched.

— Landing net. Hooks can be removed from some fish even as they remain in the net in the water. If that's not possible, lift the fish aboard and remove the hooks while the fish is held behind the head and around the tail. To better restrain large fish, stretch a piece of cloth or plastic over the fish and pin it down as if it were in a straight jacket.

— Stretcher. A stretcher is made of net or porous cloth about 2 to 3 feet wide stretched between two poles. As you draw the fish into the cradle and lift, the fold of the mesh supports and restrains the fish. This method requires two anglers.

— Tailer. Developed by Atlantic salmon anglers, a tailer is a handle with a loop at one end that is slipped over the fish's tail and tightened. The fish is thus securely held, though the head must be further restrained before the hooks are removed.

If you must lift a big fish from the water, support as much of its body as possible to avoid injuring its internal organs.

Never grip a fish by the eye sockets if you intend to release it. By doing so you abrade its eyes, injure the surrounding tissue and may cause blindness.

Catfish

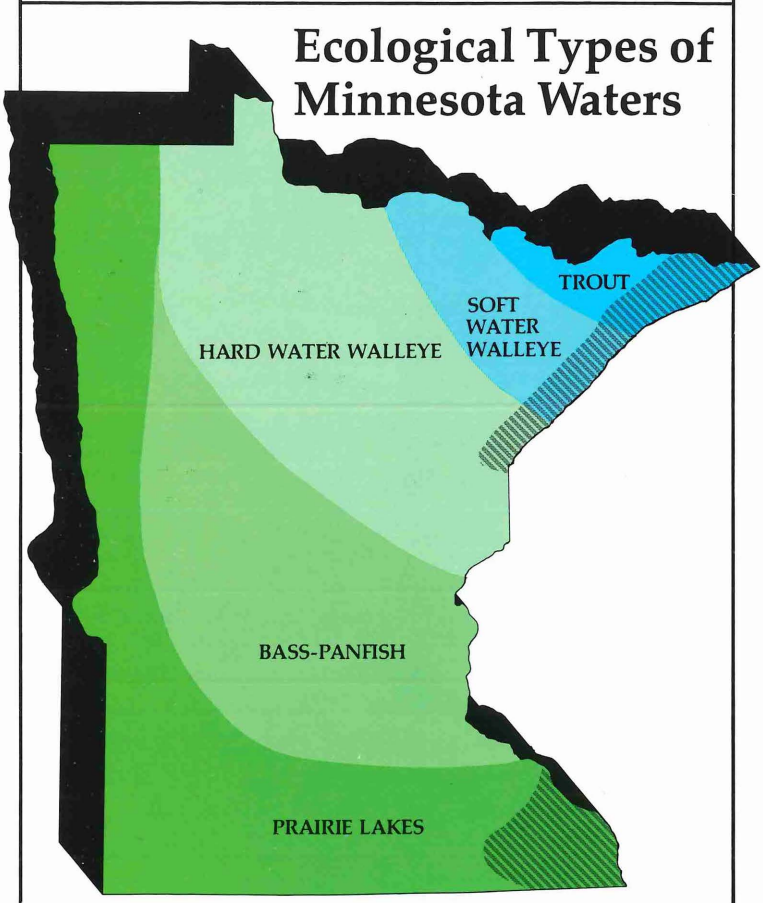
An undiscovered angling challenge, catfish and bullhead, tough to catch and great to eat — but respected by only a few

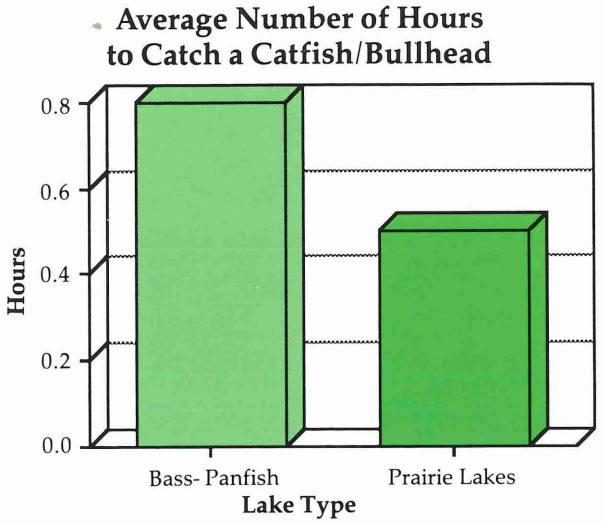
Minnesota's two species of catfish and three bullhead suffer a public relations problem. They are unknowledgeably dismissed as ''trash fish'' suited only to foul waters. Anglers forget that in many clean streams members of this family swim side by side with that most adored of Minnesota game fish, the walleye. The yellow bullhead, as another example, thrives in clear water with largemouth bass and sunfish. The flathead catfish achieves true trophy size, often exceeding 40 pounds — bigger on average than the muskie. The channel cat, though smaller than the flathead, is pound for pound one of the fightingest fish in fresh water and is quite often caught on artificial lures — even flies! On a good day you can expect to catch more of them than other well known Minnesota game fish. Catfish and bullhead are excellent table fare whether broiled, baked or fried. While they may be difficult for the novice to clean, after a little practice they skin as fast as any other species. These qualities are realized by anglers elsewhere, but among Minnesotans, this family of fish is getting a bum rap.

Five species are caught on hook and line in Minnesota: channel catfish, yellow bullhead, brown bullhead, black bullhead and the flathead. The first four species are very closely related; the flathead is a more distant cousin. All catfish have eight barbels (four on the upper jaw and four below), which are sensitive to touch and along with much of the rest of their bodies are covered by taste buds. All species have spines in the dorsal and pectoral fins that can injure a careless angler.

All three species of bullhead are popular game in Minnesota prairie regions, where bullhead are plentiful and other species are scarce. These small catfish are easy to catch and require no sophisticated equipment. They are often caught below low-head dams, where all three species may congregate in dense writhing masses.

These hardy fish are also important for their use in urban ponds, where they are stocked to provide fishing for kids, the handicapped and others who have limited mobility. In many of these small, poorly oxygenated ponds, other fish cannot survive.





This is an average of all anglers and does not accurately indicate what an expert angler might catch while fishing for this species.

Bullhead are important to commercial fishermen, who harvest about 1 million pounds a year. All three species make up the commercial catch, though the DNR is considering ways to steer commercial fishermen toward the black bullhead, to leave the larger yellow and brown bullheads for hook-and-line anglers.

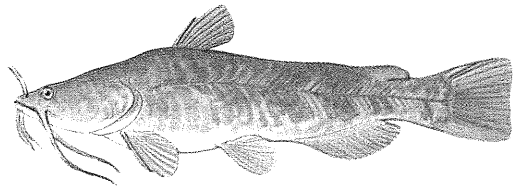
Bullhead are managed with possession limits that are extremely liberal but prevent unregulated commercial fishing. Otherwise, it is important to maintain good water quality, which favors yellow and brown bullhead over the smaller black bullhead.

Fish managers would like to increase the average size of bullhead. Since these fish are caught for the pan, not for sport, catch-and-release regulations are inappropriate. As mentioned before, perhaps flathead catfish or some other predator can control bullhead numbers, allowing the surviving fish to grow larger. Otherwise, fish toxicants might be used to the same effect. Either approach, however, would be of use only on small bodies of water.

Beyond that, catfish species differ greatly in their size, their sporting appeal, and the ways they are managed. Let's look at them species by species.

Minnesota's Catfish and Bullheads

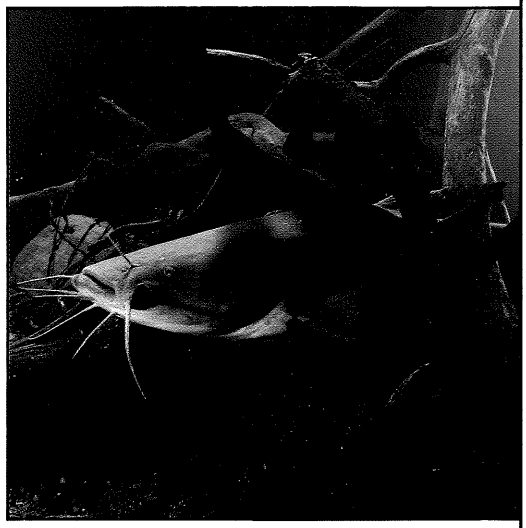
Flathead catfish: The flathead, also called the "mud cat" or "yellow cat," lives in Minnesota's large, slow rivers: the Mississippi below the Coon Rapids Dam, the St. Croix below Taylors Falls, and the Minnesota River. Its name aptly describes its anatomy, which also includes a dark back and brownish mottled sides and a broad, slightly notched tail. It is the largest catfish native to Minnesota; commercial fishermen have reported fish larger than 100 pounds.



The flathead occupies deep pools with dense cover, such as logjams. It feeds primarily on other fish, using its sense of smell and ability to detect vibration through its lateral line to hunt. At night, it may more actively feed or even forage in shallow riffles.

On rare occasion a flathead will grab an artificial lure, but usually they are caught on large live bait fish lowered into deep pools or heavy cover. Flathead generally shun the dead baits and "stink baits" so popular for channel cat.

The flathead catfish spawns in summer when the water reaches 72 to 75 degrees. It nests in cavities, such as hollow logs, root wads or log jams in quiet water. After spawning, the male drives the female from the nest — violently if necessary. The male guards the eggs and fans water over them until they hatch and may tend the swarm of young until they disperse.

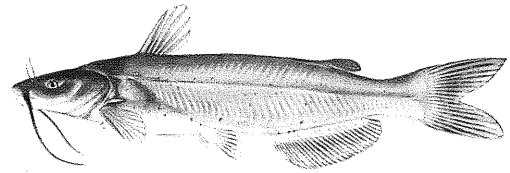


Though the flathead tolerates turbidity and temperatures in the low 90s, it requires reliable flows of well-oxygenated water.

During the winter, flatheads seek deep waters, where boulders or logs provide refuge from current. There they remain through the winter, so torpid that they may be covered by a fine dusting of silt.

Because flathead catfish eat great numbers of other fish and are good sport fish as well, fish managers have tried stocking them in lakes to control undesirable fish. In one Minnesota experiment, flathead appeared to control carp and black bullhead populations. Researchers undoubtedly will conduct more work of this sort.

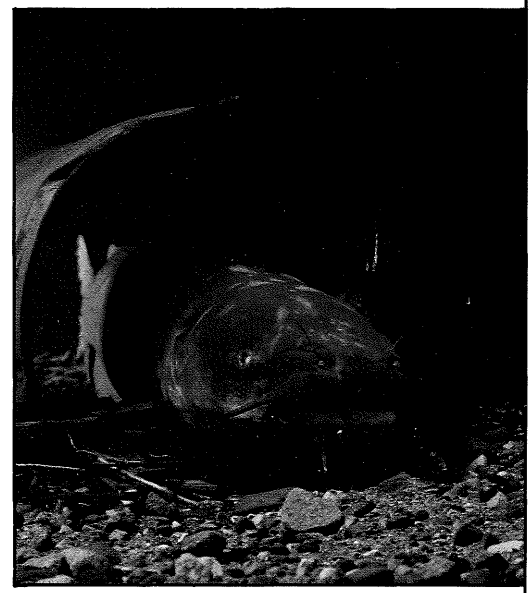
Channel catfish: Small channel cats are steel gray and peppered with dark spots; older fish are darker and lack spots. Distinguished from the flathead by its deeply forked tail, a stream channel cat ranges from 1 to 4 pounds and rarely exceeds 20 pounds.



Though channel cat and flathead coexist in large, slow rivers, the channel cat takes to smaller waters as well, sharing many riffly streams with the walleye and smallmouth bass. The channel cat ranges throughout the Mississippi, Minnesota, St. Croix, Red and St. Louis rivers and many of their tributaries. (The channel cat originally inhabited the Mississippi only below St. Anthony Falls but recently has been introduced as far upstream as St. Cloud. It apparently gained access to the St. Louis River by a connection with the St. Croix River that existed in the waning millennia of the Ice Age.)

The channel cat spawns in early summer when the water reaches 75-80 degrees. Like the flathead, it uses nesting cavities, such as hollow logs, log jams and undercut banks. It requires reliable flows of well-oxygenated water but can tolerate turbid water and temperatures in the high 90s. Murky water, in fact, protects newly hatched channel catfish from sight-feeding predators such as sunfish and bass. During the winter, the channel cat seeks deep water and protection from the current. In big-river wintering areas, channel cat and flathead may be found side by side.

The channel cat is more wide ranging than the flathead. In spring it may move many miles upstream, often into smaller tributaries. It moves downstream again in late fall. Over the course of several years it may move more than 100 miles, even through locks or over dams.



The channel cat feeds on snails, crayfish, aquatic insects, other invertebrates, and small fish. The presence of grasshoppers and other terrestrial insects in its craw indicates it occasionally feeds at the surface. Like the flathead, the channel cat can feed in the dark or in murky water, finding food by smell, touch or sensing vibration. It is much more likely than the flathead to feed on carrion or to take dead bait. On the other hand, it is also far more likely to strike a spinner, plug or jig.

The channel cat is much easier to raise in a hatchery than the flathead. While the flathead eats only live fish, including other flatheads, the channel cat thrives on hatchery pellets. Each year the DNR raises about 30,000 yearling fish at two hatcheries. It is stocked primarily in lakes, where it can become a trophy, growing much larger than it does in streams. Though the channel cat can reproduce in still water, in many lakes its numbers are maintained solely by stocking.

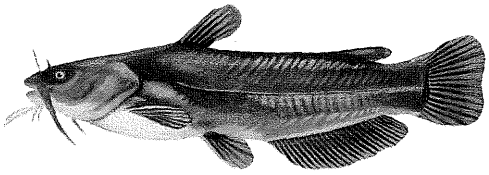
Bullhead: Minnesota has three species of bullhead. All are closely related to the larger channel cat, but are better adapted to sluggish creeks and oxygen-poor ponds and lakes. Bullhead can gulp air to survive in oxygen-depleted waters and are among the last fish to succumb to winterkill. They also tolerate pollution and common fish toxicants better than other fish. The black bullhead, in particular, is "incredibly hardy," said one fish biologist. "It needs wet grass. They're one step above rocks."

Bullhead of all three species spawn in late spring and summer, nesting in shallow depressions in sand or mud bottoms. Soon after the eggs hatch, hundreds to thousands of black young swarm near the surface as the parents patrol the margins of the school against predators. Bullhead are omnivorous, feeding on invertebrates and vegetation and some small fish. Bullhead of all species are important prey for larger game fish.

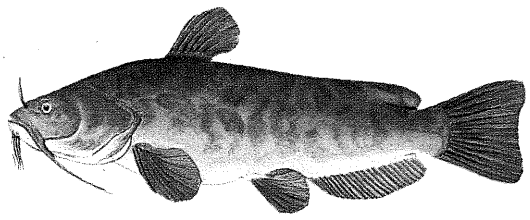
The yellow bullhead is distinguished from other bullhead species by its whitish lower barbels and rounded tail. It has 24 to 27 anal fin rays, including rudimentaries. It occasionally exceeds 2 pounds. The yellow bullhead lives in many clear, relatively deep, weedy bass-panfish lakes and ponds in central and southern Minnesota. It also occupies slow, southern streams. It requires clearer water than other bullhead species. The yellow bullhead is perhaps the most popular species because of its size and because its distribution—largely southern Minnesota—coincides with the area where bullhead are most popular.

The brown bullhead is similar in size to the yellow bullhead but has dark lower barbels and a squarer tail. Its anal fin rays total 21 to 24. It has a much more mottled pattern of brown and green than the more evenly colored black bullhead. The brown bullhead occurs throughout all but northeastern Minnesota, often occupying larger, deeper lakes than the yellow bullhead. It also lives in the Mississippi, Minnesota, St. Croix and Red rivers and their tributaries.

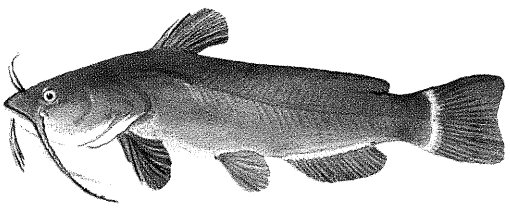
The black bullhead has dark barbels like the brown bullhead, but is more uniformly dark rather than mottled. Anal fin rays total 15 to 21. Also, it has a light bar across the base of the tail. Because the black bullhead is more tolerant of oxygen-poor water than any of its relatives, it dominates in warm, eutrophic waters, where other game fish are winter-killed. Unfortunately, they are smaller on the average than yellow and brown bullhead and so are less desirable to anglers. The black bullhead rarely reaches 15 inches; most are 6 to 10 inches. Nonetheless, black bullhead are often fished for, if only because they are common throughout their range, which includes shallow lakes and muddy streams in central and southern Minnesota as well as the St. Louis River and tributaries of the Red River. It is also common in the Rock River, a tributary of the Missouri, in far southwest Minnesota.



Yellow Bullhead



Brown Bullhead



Black Bullhead

Boating Safety Tips

MINNESOTA LAW REQUIRES:

- All watercraft to be licensed, except for sea-planes and duckboats or rice boats during respective seasons.
- Coast Guard approved personal flotation (PFD or lifesaving) devices for each person in a boat.
- Navigation lights from sunset to sunrise.

COMMON SENSE DICTATES:

- What accident causes the most deaths of anglers? Falling overboard and capsizing. If you must move around, keep your weight low and close to the center of the craft.
- Wear your personal flotation device (PFD or life preserver), especially in small boats. Models are available for all ages and boating activities. Although you are not required to **wear** one by law, a PFD is the best "life insurance" policy afloat.
- Collisions with a second boat or another object are usually due to the lack of attention, fatigue and unfamiliarity with the local water conditions.
- Keep an eye on the weather, especially on larger lakes and if you see a storm approaching, head for shore.
- Booze is bad news! Alcohol is involved in about one-half of all boating accidents. Remember alcohol isn't the sport, fishing is the sport. Enjoy it safely.

For further information on boat and water safety, contact any DNR Regional Office, conservation officer, county sheriff or write:

DNR Bureau of Information and Education
Boat and Water Safety Program
500 Lafayette Road
St. Paul, MN 55155-4046 612-296-3310

For More Information

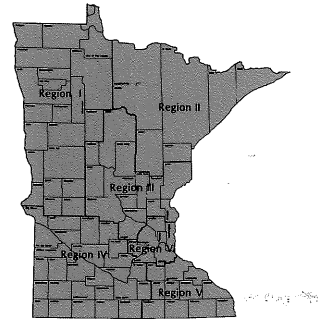
To order other pamphlets in this series, **call:**

DNR, Information Center
(612) 296-6157
In Minnesota toll-free
1 (800) 652-9747 (ask for the DNR)

Telecommunication Device for the Deaf
(612) 296-5484

or write:

Minnesota Department of Natural Resources
Section of Fisheries
500 Lafayette Road
St. Paul, MN 55155-4012



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